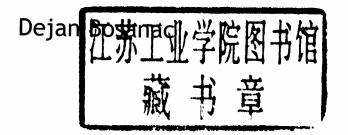
# Scripting (in) Farterns, and Patterns, and Patterns

DEJAN BOSANAC

# Scripting in Java<sup>™</sup>

Languages, Frameworks, and Patterns



## **★**Addison-Wesley

Upper Saddle River, NJ • Boston • Indianapolis • San Francisco New York • Toronto • Montreal • London • Munich • Paris • Madrid Cape Town • Sydney • Tokyo • Singapore • Mexico City Many of the designations used by manufacturers and sellers to distinguish their products are claimed as trademarks. Where those designations appear in this book, and the publisher was aware of a trademark claim, the designations have been printed with initial capital letters or in all capitals.

The author and publisher have taken care in the preparation of this book, but make no expressed or implied warranty of any kind and assume no responsibility for errors or omissions. No liability is assumed for incidental or consequential damages in connection with or arising out of the use of the information or programs contained herein.

The publisher offers excellent discounts on this book when ordered in quantity for bulk purchases or special sales, which may include electronic versions and/or custom covers and content particular to your business, training goals, marketing focus, and branding interests. For more information, please contact:

> U.S. Corporate and Government Sales (800) 382-3419 corpsales@pearsontechgroup.com

For sales outside the United States, please contact:

International Sales international@pearsoned.com



This Book Is Safari Enabled

The Safari® Enabled icon on the cover of your favorite technology book BOOKS ONLINE means the book is available through Safari Bookshelf. When you buy ENABLED this book, you get free access to the online edition for 45 days.

Safari Bookshelf is an electronic reference library that lets you easily search thousands of technical books, find code samples, download chapters, and access technical information whenever and wherever you need it.

To gain 45-day Safari Enabled access to this book:

- · Go to http://www.awprofessional.com/safarienabled
- Complete the brief registration form
- Enter the coupon code KSJV-IKCK-1XFV-SJKW-GZBS

If you have difficulty registering on Safari Bookshelf or accessing the online edition, please e-mail customer-service@safaribooksonline.com.

Visit us on the Web: www.awprofessional.com

Library of Congress Cataloging-in-Publication Data

Bosanac, Dejan. p. cm.

Scripting in java: languages, frameworks, and patterns / Dejan Bosanac.

ISBN 0-321-32193-6 (pbk. : alk. paper) 1. Java (Computer program language) 2. Programming languages (Electronic computers) I. Title.

QA76.73.J38B6715 2007 005.13'3-dc22

2007017654

Copyright © 2008 Pearson Education, Inc.

All rights reserved. Printed in the United States of America. This publication is protected by copyright, and permission must be obtained from the publisher prior to any prohibited reproduction, storage in a retrieval system, or transmission in any form or by any means, electronic, mechanical, photocopying, recording, or likewise. For information regarding permissions, write to:

> Pearson Education, Inc. Rights and Contracts Department 501 Boylston Street, Suite 900 Boston, MA 02116 Fax: (617) 671-3447

ISBN-13: 978-0-321-32193-0 ISBN-10: 0-321-32193-6

Text printed in the United States on recycled paper at RR Donnelley in Crawfordsville, IN. First printing August 2007

**EDITOR-IN-CHIEF** 

Mark Taub

**ACQUISITIONS EDITOR** 

Greg Doench

DEVELOPMENT **EDITOR** 

Audrey Doyle

MANAGING EDITOR Gina Kanouse

PROJECT EDITOR

Anne Goebel

COPY EDITOR

Geneil Breeze

INDEXER

**Brad Herriman** 

**PROOFREADER** 

Water Crest Publishing, Inc.

**PUBLISHING** COORDINATOR

Michelle Housley

**COVER DESIGNER** 

Chuti Prasertsith

COMPOSITION Bumpy Design

## **DEDICATION**

To Ivana, for being so lovely

## **PREFACE**

Java is an excellent object-oriented programming language. It has provided many benefits to software developers, including a good object-oriented approach, implicit memory management, and dynamic linking, among others. These language characteristics are one of the main reasons for Java's popularity and wide acceptance.

But Java is much more than a programming language; it's a whole development platform. This means that it comes with a runtime environment (JRE), which provides the virtual machine, and the standardized application programming interfaces (APIs) that help developers accomplish most of their desired tasks. The main advantages of this integrated runtime environment are its true platform independence and simplification of software development.

On the other hand, scripting languages have played an important role in the information technology infrastructure for many years. They have been used for all kinds of tasks, ranging from job automation to prototyping and implementation of complex software projects.

Therefore, we can conclude that the Java development platform can also benefit from scripting concepts and languages. Java developers can use scripting languages in areas proven to be most suitable for this technology. This synergy of the Java platform and scripting languages, as we will see, adds an extra quality to the overall software development process.

In this book, I describe the concepts behind scripting languages, summarize solutions available to Java developers, and explore use cases and design patterns for applying scripting languages in Java applications.

## **How This Book Is Organized**

This book consists of five logical parts.

#### Part I

The first part of the book comprises two chapters that describe scripting languages in general:

■ Chapter 1, "Introduction to Scripting"—Here I define the basic characteristics of scripting languages and compare them to system programming languages.

■ Chapter 2, "Appropriate Applications for Scripting Languages"—In this chapter, I explain the role of traditional (native) scripting languages in the overall information technology infrastructure. I also discuss tasks for which scripting languages have been used in various systems over time.

#### Part II

After discussing the basic concepts and uses of scripting languages, we are ready to focus on real technologies and solutions for the Java platform. This part of the book contains the following chapters:

- Chapter 3, "Scripting Languages Inside the JVM"—I begin this chapter by covering the basic elements of the Java platform and explaining where scripting languages fit into it. After that, I describe the main features of three popular scripting languages available for the Java Virtual Machine (JVM)—BeanShell, JavaScript, and Python—and how they can be used to interact with Java applications. At the end of this chapter, I describe other solutions available for Java developers.
- Chapter 4, "Groovy"—Here I discuss the Groovy scripting language in detail. I cover its Java-like syntax and all the scripting concepts built into this language, and I discuss Groovy's integration with Java, as well as some security-related issues.
- Chapter 5, "Advanced Groovy Programming"—In this chapter, I cover some of the Groovy extensions that can aid in day-to-day programming tasks. I also explain how Java programmers can access databases, create and process XML documents, and easily create simple Web applications and swing user interfaces, using the scripting-specific features in Groovy covered in Chapter 4.
- Chapter 6, "Bean Scripting Framework"—In this chapter, I describe the general Java scripting framework. In addition to explaining how to implement general support in your project for any compliant scripting language, I also discuss some basic abstractions implemented in the Bean Scripting Framework (BSF) and show some examples of successful uses.

#### Part III

This part of the book focuses primarily on the use of scripting languages in real Java projects:

- Chapter 7, "Practical Scripting in Java"—Here I cover topics related to the use of scripting for everyday programming tasks, such as unit testing, interactive debugging, and project building, among others.
- Chapter 8, "Scripting Patterns"—In this chapter, I discuss Java application design patterns that involve scripting languages. I show how you can use scripts to implement some parts of traditional design patterns and introduce some new design patterns specific only to the scripting environment. I also discuss the pros and cons of these design patterns, as well as their purpose.

#### Part IV

In the final part of this book, I cover the "Scripting for the Java Platform" specification, which was created according to the Java Specification Request (JSR) 223. Specifically, I cover two APIs defined by the specification:

- Chapter 9, "Scripting API"—Here I cover the Scripting API, the standard-ized general scripting framework for the Java platform. The purpose of this framework is the same as that of the Bean Scripting Framework, but the Scripting API brings many new features that the modern scripting framework needs. The Scripting API is a standard part of the Java platform with the release of Mustang (Java SE 6).
- Chapter 10, "Web Scripting Framework"—In this chapter, I discuss the Web Scripting Framework, a framework built on top of the Scripting API and created to enable scripting languages to generate Web content inside a servlet container. I explain how native scripting languages, such as PHP, can be synergized with the Java platform to bring more flexibility in Web application development.

#### Part V

At the end of the book, you can find a section comprising three appendixes. The main purpose of these appendixes is to provide the technical details about installation and use of certain technologies described in the book:

■ Appendix A, "Groovy Installation"—In this appendix, I describe how to install, build, and configure the Groovy scripting language. A working installation of the Groovy interpreter is needed to run the code samples from the text.

#### XX PREFACE

- Appendix B, "Groovy IDE Support"—In this appendix, I provide instructions on how to install general Groovy support for Integrated Development Environments (IDEs).
- Appendix C, "Installing JSR 223"—Here I describe how to install the reference implementation (RI) of the JSR 223, which is needed to run examples from Chapter 10.

I hope you'll enjoy reading the book.

### **About the Web Site**

This book is extended with a Web site at www.scriptinginjava.net where you can find the following:

- Source codes of all examples shown in the book available for download
- Book news, updates, and additions
- News and information related to this field of software development

## ACKNOWLEDGMENTS

I would like to thank my family, friends, and colleagues for endless patience and support during the writing of this book. I'm also grateful to the people from Addison-Wesley for believing in this material and making an excellent atmosphere to work in, especially my editors, Greg Doench and Ann Sellers. I would also like to thank all technical reviewers, especially George Jempty, Kevin Davis, and Rich Rosen. They have provided valuable feedback and helped me keep my focus when I was stranded. Without Audrey Doyle, this material would be much harder to read. Thank you for helping me shape the manuscript.

Finally, this book wouldn't be possible without all developers contributing their time to projects covered by this material.

## ABOUT THE AUTHOR

Dejan Bosanac is a professional software developer and technology consultant. He is focused on the integration and interoperability of different technologies, especially ones related to Java and the Web. Dejan spent a number of years in development of complex software projects, ranging from highly trafficked Web sites to enterprise applications, and was a member of the JSR 223 Expert Group.

# CONTENTS

	Preface	XVII
Part I		1
CHAPTER 1	Introduction to Scripting	3
	BACKGROUND	4
	DEFINITION OF A SCRIPTING LANGUAGE	8
	Compilers Versus Interpreters	8
	Source Code in Production	12
	Typing Strategies	13
	Data Structures	17
	CODE AS DATA	19
	SUMMARY	23
	SCRIPTING LANGUAGES AND VIRTUAL MACHINES	24
	A COMPARISON OF SCRIPTING AND SYSTEM PROGRAMMING	26
	RUNTIME PERFORMANCE	26
	DEVELOPMENT SPEED	28
	ROBUSTNESS	29
	MAINTENANCE	32
	Extreme Programming	33
	THE HYBRID APPROACH	35
	A CASE FOR SCRIPTING	37
	Conclusion	38
Chapter 2	APPROPRIATE APPLICATIONS FOR	
	CODIDEING I ANGEL OF	39
	Wiring	40
	UNIX SHELL LANGUAGES	41

	PERL	43
	TCL	43
	Prototyping	44
	Рүтном	47
	CUSTOMIZATION	49
	VISUAL BASIC FOR APPLICATIONS (VBA)	50
	SOFTWARE DEVELOPMENT SUPPORT	51
	Project Building	51
	TESTING	53
	Administration and Management	55
	USER INTERFACE PROGRAMMING	58
	TK	58
	USE CASES	59
	Web Applications	59
	SCRIPTING AND UNIX	68
	SCRIPTING IN GAMES	68
	Additional Characteristics	69
	Embeddable	70
	Extensible	70
	EASY TO LEARN AND USE	71
	Conclusion	72
Part II		75
Chapter 3	SCRIPTING LANGUAGES INSIDE THE JVM	77
	Under the Hood	80
	SCRIPTING LANGUAGE CONCEPTS	82
	BEANSHELL	83
	GETTING STARTED	83
	BASIC SYNTAX	86
	LOOSELY TYPED SYNTAX	87

	CONTENTS	IX
Syntax Flavors		88
COMMANDS		91
METHODS		91
OBJECTS		92
IMPLEMENTING INTERFACES		93
Embedding with Java		94
JYTHON		98
GETTING STARTED		98
BASIC SYNTAX		101
Working with Java		103
IMPLEMENTING INTERFACES		105
Exception Handling		107
Embedding with Java		108
Conclusion		109
RHINO		110
GETTING STARTED		110
Working with Java		111
IMPLEMENTING INTERFACES		112
JAVAADAPTER		114
Embedding with Java		114
HOST OBJECTS		117
Conclusion		120
Groovy		120
OTHER SCRIPTING LANGUAGES		122
JRUBY		122
Tcl/Java		122
JudoScript		122
ObjectScript		123
Conclusion	<u> </u>	123

Chapter 4	Groovy	125
	Why Groovy?	126
	Installation	127
	RUNNING GROOVY SCRIPTS	127
	Using the Interactive Shell	127
	USING THE INTERACTIVE CONSOLE	128
	EVALUATING THE SCRIPT FILE	129
	COMPILING GROOVY SCRIPTS	130
	Dependencies	131
	Classpath	131
	ANT TASK	132
	SCRIPT STRUCTURE	133
	COMMAND-LINE ARGUMENTS	136
	Language Syntax	137
	Java Compatibility	137
	STATEMENTS	138
	LOOSE TYPING	138
	Type Juggling	140
	Strings	143
	<b>GS</b> TRINGS	145
	REGULAR EXPRESSIONS	146
	Collections	148
	LOGICAL BRANCHING	154
	LOOPING	156
	CLASSES	159
	Operator Overloading	162
	GROOVYBEANS	165
	CLOSURES	168
	System Operations	178
	FILES	178
	Processes	182

	Co	ONTENTS	XI
	Embedding with Java	1	84
	Security	1	90
	Conclusion		94
CHAPTER 5	ADVANCED GROOVY PROGRAMMING	19	95
	GROOVYSQL	1:	96
	groovy.sql.Sql	1	98
	groovy.sql.DataSet	2	09
	Groovlets	2	12
	GROOVY TEMPLATES	23	20
	GROOVYMARKUP	22	23
	groovy.xml.MarkupBuilder		24
	groovy.util.NodeBuilder	2:	27
	groovy.xml.SaxBuilder	2.	30
	groovy.xml.DomBuilder	23	32
	groovy.xml.Namespace	23	34
	groovy.util.BuilderSupport	23	35
	GROOVY AND SWING	23	36
	TableLayout	23	39
	TableModel	24	<i>41</i>
	Conclusion	24	3
Chapter 6	BEAN SCRIPTING FRAMEWORK	24	5
	Introduction to the Bean Scripting Framewo	ORK 24	6
	GETTING STARTED	24	.7
	BASIC CONCEPTS	24	
	Architecture	24	
	REGISTRATION OF SCRIPTING LANGUAGES	24	
	Manager and Engine Initialization	25	
	Working with Scripts	25 25	
	Working with Script Files	25'	

	METHODS AND FUNCTIONS	259
	call()	259
	apply()	263
	DATA BINDING	264
	REGISTERING BEANS	265
	DECLARING BEANS	268
	COMPILATION	270
	Applications	275
	JSP	275
	XALAN-J (XSLT)	280
	Conclusion	288
Part III		289
Chapter 7	PRACTICAL SCRIPTING IN JAVA	291
	Unit Testing	292
	JUNIT BASICS	293
	THE GroovyTestCase CLASS	296
	Assertion Methods	297
	TEST SUITES	300
	SCRIPTS AS UNIT TEST CASES	303
	SUMMARY	304
	Interactive Debugging	304
	BUILD TOOLS (ANT SCRIPTING)	309
	BSF SUPPORT	313
	GroovyMarkup (AntBuilder)	316
	SUMMARY	322
	SHELL SCRIPTING	323
	Classpath	324
	EXAMPLE	325
	Administration and Management	328
	CONCLUSION	334

		CONTENTS	XIII
CHAPTER 8	SCRIPTING PATTERNS		335
	SCRIPTED COMPONENTS PATTERN		337
	Problem		337
	SOLUTION		338
	Consequences		339
	SAMPLE CODE		340
	RELATED PATTERNS		341
	MEDIATOR PATTERN (GLUE CODE P.	ATTERN)	341
	$P_{ROBLEM}$		341
	SOLUTION		342
	Consequences		345
	SAMPLE CODE		345
	RELATED PATTERNS		354
	SCRIPT OBJECT FACTORY PATTERN		354
	PROBLEM		355
	Solution		355
	Consequences		356
	Sample Code		356
	RELATED PATTERNS		359
	OBSERVER (BROADCASTERS) PATTER	N	359
	PROBLEM		359
	Solution		360
	Consequences		362
	SAMPLE CODE		362
	RELATED PATTERNS		369
	EXTENSION POINT PATTERN		369
	Problem	FE.	369
	SOLUTION		370
	Consequences		370
	SAMPLE CODE		371
	Related Patterns		374