Pro JavaScript[™] Design Patterns

Ross Harmes and Dustin Diaz

Pro JavaScript[™] Design Patterns

Copyright © 2008 by Ross Harmes and Dustin Diaz

All rights reserved. No part of this work may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or by any information storage or retrieval system, without the prior written permission of the copyright owner and the publisher.

ISBN-13 (pbk): 978-1-59059-908-2 ISBN-10 (pbk): 1-59059-908-X

ISBN-13 (electronic): 978-1-4302-0495-4 ISBN-10 (electronic): 1-4302-0495-8

Printed and bound in the United States of America 987654321

Trademarked names may appear in this book. Rather than use a trademark symbol with every occurrence of a trademarked name, we use the names only in an editorial fashion and to the benefit of the trademark owner, with no intention of infringement of the trademark.

Java and all Java-based marks are trademarks or registered trademarks of Sun Microsystems Inc. in the United States and other countries. Apress Inc. is not affiliated with Sun Microsystems Inc., and this book was written without endorsement from Sun Microsystems Inc.

Lead Editors: Chris Mills, Tom Welsh Technical Reviewer: Simon Willison

Editorial Board: Steve Anglin, Ewan Buckingham, Tony Campbell, Gary Cornell, Jonathan Gennick, Jason Gilmore, Kevin Goff, Jonathan Hassell, Matthew Moodie, Joseph Ottinger, Jeffrey Pepper, Ben Renow-Clarke. Dominic Shakeshaft. Matt Wade. Tom Welsh

Project Manager: Richard Dal Porto Copy Editor: Jennifer Whipple

Associate Production Director: Kari Brooks-Copony

Production Editor: Kelly Winquist

Compositor and Artist: Kinetic Publishing Services, LLC

Proofreader: Dan Shaw Indexer: Julie Grady

Cover Designer: Kurt Krames

Manufacturing Director: Tom Debolski

Distributed to the book trade worldwide by Springer-Verlag New York, Inc., 233 Spring Street, 6th Floor, New York, NY 10013. Phone 1-800-SPRINGER, fax 201-348-4505, e-mail orders-ny@springer-sbm.com, or visit http://www.springeronline.com.

For information on translations, please contact Apress directly at 2855 Telegraph Avenue, Suite 600, Berkeley, CA 94705. Phone 510-549-5930, fax 510-549-5939, e-mail info@apress.com, or visit http://www.apress.com.

The information in this book is distributed on an "as is" basis, without warranty. Although every precaution has been taken in the preparation of this work, neither the author(s) nor Apress shall have any liability to any person or entity with respect to any loss or damage caused or alleged to be caused directly or indirectly by the information contained in this work.

The source code for this book is available to readers at http://www.apress.com.

${\it To Mom, and those who have listened, thanks}$

—Dustin Diaz

To Alec, Dymphi, and Terry

—Ross Harmes

Contents at a Glance

About the Authors		XV
About the Technica	al Reviewer	xvii
Acknowledgments	3	xix
Introduction		xxi
PART 1	Object-Oriented JavaScript	
CHAPTER 1	Expressive JavaScript	3
CHAPTER 2	Interfaces	11
CHAPTER 3	Encapsulation and Information Hiding	25
CHAPTER 4	Inheritance	41
CHAPTER 5	The Singleton Pattern	65
CHAPTER 6	Chaining	83
	Design Patterns	
CHAPTER 7	The Factory Pattern	
CHAPTER 8	The Bridge Pattern	
CHAPTER 9	The Composite Pattern	125
CHAPTER 10	The Facade Pattern	141
CHAPTER 11	The Adapter Pattern	149
CHAPTER 12	The Decorator Pattern	
CHAPTER 13	The Flyweight Pattern	
CHAPTER 14	The Proxy Pattern	197
CHAPTER 15	The Observer Pattern	215
CHAPTER 16	The Command Pattern	225
CHAPTER 17	The Chain of Responsibility Pattern	245
INDEX		263

Contents

About the Authors	S	XV
About the Technic	cal Reviewer	xvii
Acknowledgment	ts	xix
Introduction		xxi
PART 1	Object-Oriented JavaScript	
CHAPTER 1	Expressive JavaScript	3
	The Flexibility of JavaScript	3
	A Loosely Typed Language	
	Functions As First-Class Objects	6
	The Mutability of Objects	8
	Inheritance	9
	Design Patterns in JavaScript	9
	Summary	10
CHAPTER 2	Interfaces	11
	What Is an Interface?	11
	Benefits of Using Interfaces	
	Drawbacks of Using Interfaces	
	How Other Object-Oriented Languages Handle Interfaces	
	Emulating an Interface in JavaScript	14
	Describing Interfaces with Comments	14
	Emulating Interfaces with Attribute Checking	16
	Emulating Interfaces with Duck Typing	17
	The Interface Implementation for This Book	
	The Interface Class	
	When to Use the Interface Class	
	How to Use the Interface Class	
	Example: Using the Interface Class	
	Patterns That Rely on the Interface	
	Summary	23

CHAPTER 3	Encapsulation and Information Hiding	25
	The Information Hiding Principle	25
	Encapsulation vs. Information Hiding	
	The Role of the Interface	
	Basic Patterns	26
	Fully Exposed Object	27
	Private Methods Using a Naming Convention	30
	Scope, Nested Functions, and Closures	32
	Private Members Through Closures	33
	More Advanced Patterns	
	Static Methods and Attributes	35
	Constants	37
	Singletons and Object Factories	38
	Benefits of Using Encapsulation	39
	Drawbacks to Using Encapsulation	39
	Summary	40
CHAPTER 4	Inheritance	41
	Why Do You Need Inheritance?	41
	Classical Inheritance	42
	The Prototype Chain	42
	The extend Function	43
	Prototypal Inheritance	
	Asymmetrical Reading and Writing of Inherited Members	46
	The clone Function	
	Comparing Classical and Prototypal Inheritance	49
	Inheritance and Encapsulation	
	Mixin Classes	50
	Example: Edit-in-Place	
	Using Classical Inheritance	
	Using Prototypal Inheritance	
	Using Mixin Classes	
	When Should Inheritance Be Used?	
	Summary	63
CHAPTER 5	The Singleton Pattern	65
	The Basic Structure of the Singleton	65
	Namespacing	66

	A Singleton As a Wrapper for Page-Specific Code	. 70 . 70 . 71 . 74
	Lazy Instantiation	
	Example: Creating XHR Objects with Branching	
	When Should the Singleton Pattern Be Used?	
	Benefits of the Singleton Pattern	
	Drawbacks of the Singleton Pattern	
	Summary	. 82
CHAPTER 6	Chaining	. 83
	The Structure of a Chain	. 84
	Building a Chainable JavaScript Library	. 86
	Using Callbacks to Retrieve Data from Chained Methods	
	Summary	. 90
PART 2 CHAPTER 7	-	
	■ Design Patterns	. 93
	■ Design Patterns The Factory Pattern	. 93
	Design Patterns The Factory Pattern The Simple Factory The Factory Pattern. When Should the Factory Pattern Be Used?	. 93 . 93 . 96 . 99
	The Factory Pattern The Simple Factory The Factory Pattern When Should the Factory Pattern Be Used? Dynamic Implementations	. 93 . 93 . 96 . 99
	Design Patterns The Factory Pattern The Simple Factory The Factory Pattern. When Should the Factory Pattern Be Used? Dynamic Implementations Combining Setup Costs.	. 93 . 93 . 96 . 99 . 99
	The Factory Pattern The Simple Factory The Factory Pattern When Should the Factory Pattern Be Used? Dynamic Implementations Combining Setup Costs. Abstracting Many Small Objects into One Large Object	. 93 . 93 . 96 . 99 . 99
	The Factory Pattern The Simple Factory The Factory Pattern When Should the Factory Pattern Be Used? Dynamic Implementations Combining Setup Costs. Abstracting Many Small Objects into One Large Object Example: XHR Factory.	. 93 . 93 . 96 . 99 . 99 . 99
	Design Patterns The Factory Pattern The Simple Factory The Factory Pattern. When Should the Factory Pattern Be Used? Dynamic Implementations Combining Setup Costs. Abstracting Many Small Objects into One Large Object Example: XHR Factory. Specialized Connection Objects	. 93 . 96 . 99 . 99 . 99 . 99
	The Factory Pattern The Simple Factory The Factory Pattern When Should the Factory Pattern Be Used? Dynamic Implementations Combining Setup Costs. Abstracting Many Small Objects into One Large Object Example: XHR Factory. Specialized Connection Objects Choosing Connection Objects at Run-Time.	. 93 . 93 . 96 . 99 . 99 . 99 . 99 101 103
	The Factory Pattern The Simple Factory The Factory Pattern When Should the Factory Pattern Be Used? Dynamic Implementations Combining Setup Costs. Abstracting Many Small Objects into One Large Object Example: XHR Factory. Specialized Connection Objects Choosing Connection Objects at Run-Time. Example: RSS Reader	. 93 . 93 . 96 . 99 . 99 . 99 . 99 101 103 104
	The Factory Pattern The Simple Factory The Factory Pattern When Should the Factory Pattern Be Used? Dynamic Implementations Combining Setup Costs. Abstracting Many Small Objects into One Large Object Example: XHR Factory. Specialized Connection Objects Choosing Connection Objects at Run-Time.	. 93 . 96 . 99 . 99 . 99 . 99 101 103 104 107

CHAPTER 8	The Bridge Pattern	109
	Example: Event Listeners	109
	Other Examples of Bridges	110
	Bridging Multiple Classes Together	111
	Example: Building an XHR Connection Queue	111
	Including the Core Utilities	112
	Including an Observer System	114
	Developing the Queue Skeleton	114
	Implementing the Queue	116
	Where Have Bridges Been Used?	122
	When Should the Bridge Pattern Be Used?	122
	Benefits of the Bridge Pattern	123
	Drawbacks of the Bridge Pattern	
	Summary	123
CHAPTER 9	The Composite Pattern	125
	The Structure of the Composite	126
	Using the Composite Pattern	
	Example: Form Validation	
	Putting It All Together	
	Adding Operations to FormItem	
	Adding Classes to the Hierarchy	
	Adding More Operations	
	Example: Image Gallery	
	Benefits of the Composite Pattern	
	Drawbacks of the Composite Pattern	
	Summary	
CHAPTER 10	The Facade Pattern	141
	Some Facade Functions You Probably Already Know About	141
	JavaScript Libraries As Facades	
	Facades As Convenient Methods	
	Example: Setting Styles on HTML Elements	
	Example: Creating an Event Utility	
	General Steps for Implementing the Facade Pattern	
	When Should the Facade Pattern Be Used?	
	Benefits of the Facade Pattern	
	Drawbacks of the Facade Pattern	
	Summary	1/18

CHAPTER 11	The Adapter Pattern	149
	Characteristics of an Adapter	
	Example: Adapting One Library to Another	
	Example: Adapting an Email API	
	Wrapping the Webmail API in an Adapter	
	Migrating from fooMail to dedMail	
	When Should the Adapter Pattern Be Used?	
	Benefits of the Adapter Pattern	
	Drawbacks of the Adapter Pattern	
	Summary	
CHAPTER 12	The Decorator Pattern	. 159
	The Structure of the Decorator	
	The Role of the Interface in the Decorator Pattern	
	The Decorator Pattern vs. the Composite Pattern	
	In What Ways Can a Decorator Modify Its Component?	
	Adding Behavior After a Method	
	Adding Behavior Before a Method	
	Replacing a Method.	
	Adding New Methods	
	The Role of the Factory.	
	Function Decorators	
	When Should the Decorator Pattern Be Used?	
	Example: Method Profiler	
	Benefits of the Decorator Pattern	
	Drawbacks of the Decorator Pattern	
	Summary	. 1//
CHAPTER 13	The Flyweight Pattern	. 179
	The Structure of the Flyweight	179
	Example: Car Registrations	179
	Intrinsic and Extrinsic State	180
	Instantiation Using a Factory	181
	Extrinsic State Encapsulated in a Manager	
	Managing Extrinsic State	
	Example: Web Calendar	183
	Converting the Day Objects to Flyweights	185
	Where Do You Store the Extrinsic Data?	186

	Example: Tooltip Objects	186
	The Unoptimized Tooltip Class	187
	Tooltip As a Flyweight	188
	Storing Instances for Later Reuse	190
	When Should the Flyweight Pattern Be Used?	192
	General Steps for Implementing the Flyweight Pattern	
	Benefits of the Flyweight Pattern	
	Drawbacks of the Flyweight Pattern	
	Summary	
CHAPTER 14	The Proxy Pattern	197
	The Structure of the Proxy	197
	How Does the Proxy Control Access to Its Real Subject?	
	Virtual Proxy, Remote Proxy, and Protection Proxy	
	The Proxy Pattern vs. the Decorator Pattern	
	When Should the Proxy Be Used?	
	Example: Page Statistics	
	General Pattern for Wrapping a Web Service	
	Example: Directory Lookup	
	General Pattern for Creating a Virtual Proxy	
	Benefits of the Proxy Pattern	
	Drawbacks of the Proxy Pattern	
	Summary	
CHAPTER 15	The Observer Pattern	215
	Example: Newspaper Delivery	215
	Push vs. Pull	
	Pattern in Practice	216
	Building an Observer API	218
	Delivery Method	219
	Subscribe	
	Unsubscribe	
	Observers in Real Life	220
	Example: Animation	221
	Event Listeners Are Also Observers	
	When Should the Observer Pattern Be Used?	
	Benefits of the Observer Pattern	223
	Drawbacks of the Observer Pattern	223
	Summary	223

CHAPTER 16	The Command Pattern	225
	The Structure of the Command	225
	Creating Commands with Closures	227
	The Client, the Invoker, and the Receiver	227
	Using Interfaces with the Command Pattern	228
	Types of Command Objects	228
	Example: Menu Items	
	The Menu Composites	231
	The Command Class	233
	Putting It All Together	234
	Adding More Menu Items Later On	235
	Example: Undo and Logging	235
	Commands	239
	Logging Commands for Crash Recovery	242
	When to Use the Command Pattern	242
	Benefits of the Command Pattern	243
	Drawbacks of the Command Pattern	243
	Summary	244
CHAPTER 17	The Chain of Responsibility Pattern	245
	The Structure of the Chain of Responsibility	245
	Passing on Requests	
	Implementing a Chain of Responsibility in an Existing Hierarchy	
	Event Delegation	
	When Should the Chain of Responsibility Pattern Be Used?	
	Example: Image Gallery Revisited	
	Using the Chain of Responsibility to Make Composites	
	More Efficient	257
	Adding Tags to Photos	
	Benefits of the Chain of Responsibility Pattern	
	Drawbacks of the Chain of Responsibility Pattern	
	Summary	
INDEX		263