# Table of Contents

Preface ................................................................................................................................. xii  
1. Spring: Evolution Over Intelligent Design ................................................................. xii  
2. A Little History ........................................................................................................... xii  
3. Goals of This Book .................................................................................................... xiii  
4. A Note about Format ................................................................................................. xiii  

I. Spring Introduction ........................................................................................................ 15

Spring In Context: Core Concepts .................................................................................. 16

1. Spring and Inversion of Control ............................................................................... 17
   - Dependency Inversion: Precursor to Dependency Injection .................................. 17
2. Dependency Injection To The Rescue ........................................................................ 20
3. Bean management through IoC ............................................................................... 21
4. Our Example In Spring IoC .................................................................................... 21

A Practical Introduction to Inversion of Control ......................................................... 22

1. Basic Bean Creation ............................................................................................... 22
2. Basic Constructor Injection ...................................................................................... 23
3. Basic Setter Injection .............................................................................................. 24
4. Reference Injection ................................................................................................ 25
5. Creating a Spring Application ............................................................................... 26
6. Unit Test Beans from Application Context .......................................................... 27
7. Getting Started ...................................................................................................... 29
   - Setup .................................................................................................................. 29
8. Reference ............................................................................................................. 29
   - Related Links ................................................................................................. 30
   - Project Information ......................................................................................... 30

II. Core ............................................................................................................................ 31

AspectJ Load-time Weaving in Spring ......................................................................... 32

1. JVM Argument ..................................................................................................... 32
2. Spring Configuration .............................................................................................. 32
3. AspectJ Configuration ............................................................................................ 33
4. Code Example ....................................................................................................... 33
5. Reference ............................................................................................................. 34
   - Related Links ................................................................................................. 34
   - Project Setup ................................................................................................. 34
   - Project Information ......................................................................................... 34

III. Persistence .................................................................................................................. 35

Simple Spring JDBC Template ..................................................................................... 36

1. Spring Configuration .............................................................................................. 36
2. Code Example ........................................................................................................ 36
3. Reference ............................................................................................................. 36
   - Related Links ................................................................................................. 37

Simple Hibernate XML Configuration ......................................................................... 38

1. Spring Configuration .............................................................................................. 38
2. Hibernate Configuration ......................................................................................... 38
3. SQL Script ............................................................................................................. 39
<table>
<thead>
<tr>
<th>Section</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring Data JPA</td>
<td>79</td>
</tr>
<tr>
<td>1. Spring Configuration</td>
<td>79</td>
</tr>
<tr>
<td>2. JPA Configuration</td>
<td>80</td>
</tr>
<tr>
<td>3. Repository</td>
<td>80</td>
</tr>
<tr>
<td>4. Code Example</td>
<td>82</td>
</tr>
<tr>
<td>5. Reference</td>
<td>84</td>
</tr>
<tr>
<td>Related Links</td>
<td>84</td>
</tr>
<tr>
<td>Project Setup</td>
<td>84</td>
</tr>
<tr>
<td>Project Information</td>
<td>85</td>
</tr>
<tr>
<td>Spring Data JPA Auditing</td>
<td>86</td>
</tr>
<tr>
<td>1. Spring Configuration</td>
<td>86</td>
</tr>
<tr>
<td>2. JPA Configuration</td>
<td>86</td>
</tr>
<tr>
<td>3. Code Example</td>
<td>87</td>
</tr>
<tr>
<td>4. SQL Script</td>
<td>89</td>
</tr>
<tr>
<td>5. Reference</td>
<td>90</td>
</tr>
<tr>
<td>Related Links</td>
<td>90</td>
</tr>
<tr>
<td>Project Setup</td>
<td>90</td>
</tr>
<tr>
<td>Project Information</td>
<td>91</td>
</tr>
<tr>
<td>Hibernate Transaction Annotation Configuration</td>
<td>92</td>
</tr>
<tr>
<td>1. Spring Configuration</td>
<td>92</td>
</tr>
<tr>
<td>2. Code Example</td>
<td>92</td>
</tr>
<tr>
<td>3. Reference</td>
<td>93</td>
</tr>
<tr>
<td>Related Links</td>
<td>93</td>
</tr>
<tr>
<td>Project Setup</td>
<td>94</td>
</tr>
<tr>
<td>Project Information</td>
<td>94</td>
</tr>
<tr>
<td>Simple Spring Transactional JUnit 4 Test</td>
<td>95</td>
</tr>
<tr>
<td>1. Spring Configuration</td>
<td>95</td>
</tr>
<tr>
<td>2. Code Example</td>
<td>95</td>
</tr>
<tr>
<td>3. Reference</td>
<td>97</td>
</tr>
<tr>
<td>Related Links</td>
<td>97</td>
</tr>
<tr>
<td>Project Setup</td>
<td>97</td>
</tr>
<tr>
<td>Project Information</td>
<td>98</td>
</tr>
<tr>
<td>IV. Web</td>
<td>99</td>
</tr>
<tr>
<td>Simple Tiles 2 Spring MVC Webapp</td>
<td>100</td>
</tr>
<tr>
<td>1. Spring Configuration</td>
<td>100</td>
</tr>
<tr>
<td>2. Tiles XML Configuration</td>
<td>100</td>
</tr>
<tr>
<td>3. JSP Example</td>
<td>101</td>
</tr>
<tr>
<td>4. Reference</td>
<td>102</td>
</tr>
<tr>
<td>Related Links</td>
<td>102</td>
</tr>
<tr>
<td>Project Setup</td>
<td>102</td>
</tr>
<tr>
<td>Project Information</td>
<td>102</td>
</tr>
<tr>
<td>Basic Webapp Internationalization</td>
<td>103</td>
</tr>
<tr>
<td>1. Web Configuration</td>
<td>103</td>
</tr>
<tr>
<td>2. Spring Configuration</td>
<td>103</td>
</tr>
<tr>
<td>3. JSP Example</td>
<td>104</td>
</tr>
<tr>
<td>4. Message Resource Property Files</td>
<td>105</td>
</tr>
<tr>
<td>5. Reference</td>
<td>105</td>
</tr>
<tr>
<td>Related Links</td>
<td>105</td>
</tr>
<tr>
<td>Project Setup</td>
<td>105</td>
</tr>
</tbody>
</table>
V. Enterprise ................................................................. 159

Simple Spring JMX ................................................................. 160
  1. Producer Configuration .................................................. 160
     Spring Configuration .................................................... 160
     Code Example ............................................................ 161
  2. Client Configuration ...................................................... 161
     Spring Configuration .................................................... 162
     Code Example ............................................................ 162
  3. Reference ........................................................................ 163
     Related Links ............................................................... 163
     Project Setup ............................................................... 163
     Project Information .................................................... 164

Simple Spring Web Services ............................................... 165
  1. Server Configuration ..................................................... 165
     Web Configuration ....................................................... 165
     Spring Configuration .................................................... 165
     XML Schema Descriptor ............................................... 166
     Code Example ............................................................ 167
  2. Client Configuration ...................................................... 168
     Spring Configuration .................................................... 168
     Code Example ............................................................ 169
  3. Unit Test ........................................................................ 169
     Spring Configuration .................................................... 169
  4. Reference ........................................................................ 171
     Related Links ............................................................... 171
     Project Setup ............................................................... 171
     Project Information .................................................... 171

Embedded Spring Web Services ........................................... 172
  1. Spring Configuration ..................................................... 172
  2. Code Example .............................................................. 174
  3. Reference ........................................................................ 175
     Related Links ............................................................... 175
     Project Setup ............................................................... 176
     Project Information .................................................... 176

Simple Spring Integration ................................................... 177
  1. Spring Configuration ..................................................... 177
  2. Code Example .............................................................. 178
  3. Reference ........................................................................ 181
     Related Links ............................................................... 181
     Project Setup ............................................................... 181
     Project Information .................................................... 181

Spring JMX ........................................................................ 182
  1. Spring Configuration ..................................................... 182
2. Code Example ........................................................................................................... 183
3. Reference ................................................................................................................... 185
   Related Links ............................................................................................................ 185
   Project Setup ............................................................................................................ 185
   Project Information ................................................................................................. 185
Spring Modules JCR Node Creation & Retrieval .............................................................. 186
1. Spring Configuration .............................................................................................. 186
2. Code Example ......................................................................................................... 186
3. Reference ................................................................................................................... 189
   Related Links ............................................................................................................ 189
   Project Setup ............................................................................................................ 189
   Test Setup ................................................................................................................ 189
   Project Information ................................................................................................. 192
Velocity E-mail Template ............................................................................................ 190
1. Spring Configuration .............................................................................................. 190
2. Code Example ......................................................................................................... 191
3. Reference ................................................................................................................... 192
   Related Links ............................................................................................................ 192
   Project Setup ............................................................................................................ 192
   Test Setup ................................................................................................................ 192
   Project Information ................................................................................................. 193
Solr Client ..................................................................................................................... 194
1. Connecting to Solr using SolrOxmClient ................................................................. 194
   Spring Configuration .............................................................................................. 194
   Code Example ......................................................................................................... 195
2. Connecting to Solr using HttpClientTemplate & HttpClientOxmTemplate .......... 199
   Spring Configuration .............................................................................................. 199
   Code Example ......................................................................................................... 200
3. Reference ................................................................................................................... 202
   Related Links ............................................................................................................ 202
   Project Setup ............................................................................................................ 202
   Project Information ................................................................................................. 203
VI. Contact Application ............................................................................................... 204
Contact Application DAO ............................................................................................ 205
1. Spring Configuration .............................................................................................. 205
2. JPA Configuration ..................................................................................................... 207
3. JPA Configuration ..................................................................................................... 208
4. Reference ................................................................................................................... 209
   Related Links ............................................................................................................ 209
   Project Setup ............................................................................................................ 209
   Project Information ................................................................................................. 209
Contact Application Web Service Beans ........................................................................ 211
1. Spring Configuration .............................................................................................. 211
2. JAXB Configuration ................................................................................................. 211
3. Reference ................................................................................................................... 216
   Related Links ............................................................................................................ 216
   Project Setup ............................................................................................................ 216
   Project Information ................................................................................................. 217
Contact Application Services ....................................................................................... 218
1. Spring Configuration .............................................................................................. 218
VII. Spring dm Server .............................................................................................................. 265

Simple Message Service ........................................................................................................ 266

1. Message Service Bundle 1.0 .......................................................................................... 266
   Manifest Configuration .................................................................................................. 266
   Spring Configuration .................................................................................................. 267
   Code Example ........................................................................................................... 268

2. Message Service Bundle 1.1 .......................................................................................... 269
   Manifest Configuration .................................................................................................. 269
   Spring Configuration .................................................................................................. 269
   Code Example ........................................................................................................... 270

3. Message Service Web Module ...................................................................................... 271
   Manifest Configuration .................................................................................................. 271
   Spring Configuration .................................................................................................. 272
   JSP Example ............................................................................................................. 273
   Code Example ........................................................................................................... 273

4. Reference ...................................................................................................................... 274
   Related Links ............................................................................................................. 274
   Project Setup .............................................................................................................. 274
   Project Information .................................................................................................... 275

Simple Spring MVC ............................................................................................................. 276

1. Simple Spring MVC PAR .............................................................................................. 276
   Manifest Configuration .................................................................................................. 276

2. Simple Spring MVC DataSource Bundle ...................................................................... 277
   Manifest Configuration .................................................................................................. 277
   Spring Configuration .................................................................................................. 278

3. Simple Spring MVC Person DAO Bundle .................................................................. 279
   Manifest Configuration .................................................................................................. 279
   JPA Configuration ....................................................................................................... 279
   Spring Configuration .................................................................................................. 280
   Code Example ........................................................................................................... 281

4. Simple Spring MVC Web Module ................................................................................. 284
   Manifest Configuration .................................................................................................. 284
   Spring Configuration .................................................................................................. 285
   JSP Example ............................................................................................................. 287
   Code Example ........................................................................................................... 289

5. Reference ...................................................................................................................... 290
   Related Links ............................................................................................................. 290
   Project Setup .............................................................................................................. 291
   Project Information .................................................................................................... 291

VIII. Modules ....................................................................................................................... 292

Module Summary ............................................................................................................... 293

1. Downloads ..................................................................................................................... 293
   Custom ServletContext Scope Module ....................................................................... 293
   Custom Thread Scope Module .................................................................................... 293
   Dynamic Tiles Module ............................................................................................... 294
   Spring by Example JCR Module .................................................................................. 294
   Spring by Example Utils Module ................................................................................ 294
   Spring by Example Web Module ................................................................................ 295
<table>
<thead>
<tr>
<th>Module</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring by Example Custom ServletContext Scope Module</td>
<td>296</td>
</tr>
<tr>
<td>1. Spring Configuration</td>
<td>296</td>
</tr>
<tr>
<td>2. Download</td>
<td>297</td>
</tr>
<tr>
<td>3. Reference</td>
<td>297</td>
</tr>
<tr>
<td>Related Links</td>
<td>297</td>
</tr>
<tr>
<td>Project Setup</td>
<td>297</td>
</tr>
<tr>
<td>Project Information</td>
<td>298</td>
</tr>
<tr>
<td>Spring by Example Custom Thread Scope Module</td>
<td>299</td>
</tr>
<tr>
<td>1. Spring Configuration</td>
<td>299</td>
</tr>
<tr>
<td>2. Code Example</td>
<td>299</td>
</tr>
<tr>
<td>3. Download</td>
<td>300</td>
</tr>
<tr>
<td>4. Reference</td>
<td>300</td>
</tr>
<tr>
<td>Related Links</td>
<td>301</td>
</tr>
<tr>
<td>Project Setup</td>
<td>301</td>
</tr>
<tr>
<td>Project Information</td>
<td>301</td>
</tr>
<tr>
<td>Dynamic Tiles 2 Spring MVC Module</td>
<td>302</td>
</tr>
<tr>
<td>1. Spring Configuration</td>
<td>302</td>
</tr>
<tr>
<td>2. Tiles XML Configuration</td>
<td>303</td>
</tr>
<tr>
<td>3. Tiles JSP Example</td>
<td>303</td>
</tr>
<tr>
<td>4. DynamicTilesView</td>
<td>304</td>
</tr>
<tr>
<td>Processing Order</td>
<td>304</td>
</tr>
<tr>
<td>5. Download</td>
<td>305</td>
</tr>
<tr>
<td>6. Reference</td>
<td>305</td>
</tr>
<tr>
<td>Related Links</td>
<td>305</td>
</tr>
<tr>
<td>Project Setup</td>
<td>306</td>
</tr>
<tr>
<td>Project Information</td>
<td>306</td>
</tr>
<tr>
<td>Spring by Example JCR Module</td>
<td>307</td>
</tr>
<tr>
<td>1. Spring Configuration</td>
<td>307</td>
</tr>
<tr>
<td>2. Code Example</td>
<td>308</td>
</tr>
<tr>
<td>3. Download</td>
<td>309</td>
</tr>
<tr>
<td>4. Reference</td>
<td>310</td>
</tr>
<tr>
<td>Related Links</td>
<td>310</td>
</tr>
<tr>
<td>Project Setup</td>
<td>310</td>
</tr>
<tr>
<td>Project Information</td>
<td>310</td>
</tr>
<tr>
<td>Spring by Example Utils Module</td>
<td>311</td>
</tr>
<tr>
<td>1. HttpClientTemplate</td>
<td>311</td>
</tr>
<tr>
<td>Spring Configuration</td>
<td>311</td>
</tr>
<tr>
<td>Code Example</td>
<td>312</td>
</tr>
<tr>
<td>2. HttpClientOxmTemplate</td>
<td>315</td>
</tr>
<tr>
<td>Spring Configuration</td>
<td>315</td>
</tr>
<tr>
<td>Code Example</td>
<td>315</td>
</tr>
<tr>
<td>3. SolrOxmClient</td>
<td>316</td>
</tr>
<tr>
<td>Spring Configuration</td>
<td>316</td>
</tr>
<tr>
<td>Code Example</td>
<td>316</td>
</tr>
<tr>
<td>4. Logger BeanPostProcessor</td>
<td>317</td>
</tr>
<tr>
<td>Spring Configuration</td>
<td>317</td>
</tr>
<tr>
<td>Code Example</td>
<td>319</td>
</tr>
<tr>
<td>5. Download</td>
<td>320</td>
</tr>
</tbody>
</table>
Preface
Susan Kerschbaumer
2009

Winter slumbering in the open air,
Wears on his smiling face a dream of Spring!
—Samuel Taylor Coleridge

The Spring framework is aptly named – in many ways Spring ushers in a new season for Java programming, and brings a sense of renewal to Java's roots in portability and object oriented concepts. Spring evolved from the needs of the J2EE community at a particular moment in time. In the process it has become a much broader tool in the drive toward more modular, portable, and now, aspect oriented, programming. If you are a Java programmer and have access to a JVM, you can leverage any part of Spring to begin to build applications that are easier to code, easier to test, and easier to manage. This book will show you how.

1 Spring: Evolution Over Intelligent Design

One of the reasons that Spring has become so popular and so usable is the simple fact that it is evolving. Yes, there was some intelligent design involved at its inception (thanks to Spring's creator Rod Johnson). But what started out as a good idea to help address some very specific problems for J2EE developers became a conversation, a dialog with the developer community. This conversation has helped to shape the direction of this thing we call Spring.

Programmers are linguists. We make up words, assemble grammars, and use them to express concepts both abstract and concrete. The evolution of programming languages and technologies, Spring included, has been inspired and conducted by the people that use them. And just as in every language, usage dictates meaning.

From procedural, to object oriented, and to the newer linguistics of aspect oriented programming, the way we think about coding is eternally evolving alongside the languages and technologies we use. Spring evolved from within a context of needed change in Java programming environments. Not only has Spring popularized some core best practices in Java development, it is now influencing the evolution of Java itself.

2 A Little History

The Spring framework began as one programmer's need to solve a set of problems that Sun had tried to solve through edict in the Enterprise JavaBeans (EJB) Specification. At the time, companies were putting a lot of money and effort into developing web applications. The lack of established industry standards made management nervous, and development, haphazard. The J2EE specification promised scalability, security, high availability. Enterprise JavaBeans (EJB), as part of the J2EE suite of specifications from Sun, were intended to be as reusable and portable as their non-enterprise counterparts, plain JavaBeans.

When the final draft of the first EJB specification was released in 1998, Java web programmers looked to it as the golden child of enterprise web development.

But what they found was that the many interfaces and configuration files required to create an EJB were awkward, tedious, and prone to error. The EJBs' marriage to the container made unit testing close to impossible. And applications became heavy in the bulk of extra container features.
Since then, certain IDEs and EJB 3.0 have addressed some of these issues, but to many application developers, it's too little, too late.

The reality is that while Java and your business needs are here to stay, everything in between is likely to change, and change often. This takes us back to Java's early notion of portability (“compile once, run everywhere”) - portability is important because in today's programming environment, hardware, operating systems, IDEs, and containers, rapidly change.

Spring provides a POJO (Plain Old Java Object) based configuration environment, a container to manage the instantiation and lifecycle of your POJO components, and a framework to help you put into place some established best practices for your applications. The idea behind Spring is that your code should be well-factored, and components, kept pristine. Your components should run with or without a container, and be testable with minimal to no intrusion from outside classes. In essence, your components should have a life outside of the framework.

And as complete entities unto the themselves, these truly modular components should have a loose affiliation with other components but should not be bogged down in these dependencies. Component factoring in this way has become central to object oriented programming.

While helping you make your code more truly object oriented, Spring introduces you to two new grammars in the world of application development – the Inversion of Control (IoC) container and Aspect Oriented Programming (AOP). Both of these concepts arose naturally from the needs of developers to improve maintainability, productivity, portability, and design.

Spring also provides practical and modular solutions to JDBC connectivity and transaction management. These solutions offer a superset of the traditional JDBC and JTA offered in J2EE containers. The modular design of these aspects of Spring also allow you to leverage these pieces outside of the context of Spring's container.

And this is the beauty of Spring. Spring provides all of these features and tools, and more, in a non-intrusive framework. Spring is a container, but it is also a set of utilities which can be used outside of the container. And in keeping with the idea of portability, the authors of Spring have taken into account where your applications might be today (tangled up in EJB interfaces, or RMI services, for example), and have provided means to port your existing code as simply as possible.

### 3 Goals of This Book

Spring was not developed in a boardroom and as a result it has a vibrant and sometimes confusing context. This book will first introduce you to the core concepts behind Spring and how Spring will make your life easier (and more interesting!). Spring is built around a few key patterns and some relatively new concepts in Java programming. In this book after the introduction, each article will be based on a working example available from the Spring by Example Subversion repository [http://svn.springbyexample.org/].

While Spring evolved out of the J2EE realm, in keeping with the idea that Java components should not be tied to a particular architecture, we only require that you have some knowledge of Java and XML in order to understand and make use of most of this book. Although more advanced examples may require some additional knowledge to understand the example fully, but there are references at the end of each example to read more about the subject covered.

### 4 A Note about Format
New terms appear in bold italics the first time they are defined or described. Buzzwords, or keywords that have already been defined but that are important to a concept being explained may then appear in italics. Direct references to coding examples in the text of the book (methods, classnames, etc), and the coding examples themselves, are displayed in courier font, otherwise known as That Typewriter Typeface (TTT). Incidentally, there are a lot of acronyms in this book and some of them may be new to you. Generally if the acronym is the most common way to refer to a particular term, we will use the term, followed by the acronym, the first time it is mentioned in a section. The acronym will be used for the remainder of the section.
Part I. Spring Introduction

Basic introduction to Inversion of Control (IoC), Dependency Injection (DI), and the Spring Framework.
Spring In Context: Core Concepts

Susan Kerschbaumer
David Winterfeldt
2009

...The architecture that actually predominates in practice has yet to be discussed: the BIG BALL OF MUD...A BIG BALL OF MUD is haphazardly structured, sprawling, sloppy, duct-tape and bailingwire, spaghetti code jungle...Why is this architecture so popular?...Can we avoid this? Should we? How can we make such systems better?

— Big Ball of Mud, by Brian Foote and Joseph Yoder

Everyone knows the Big Ball of Mud. You've either written it (accidentally of course), you've had to read it, or you've had to refactor it. The Big Ball of Mud is disorganized, unwieldy code -- it blossomed in the late 1990's when the dotcom boom was in full force and there was great demand for fast application development, technology personnel was constantly in flux, and core technologies were changing regularly in order to accommodate issues of scalability.

Today the Big Ball of Mud behaves more like The Blob\(^1\), growing larger as it consumes more application functionality, and threatening to swallow up good coding practices everywhere. Disorganized and poorly factored applications can be disastrous -- wasteful, expensive, and miserable to work with. Sometimes The Big Ball of Mud is so unwieldy it can't be worked with at all.

Fortunately, as web applications began to standardize on J2EE platforms (now known, and from here on referred to, as Java EE), design patterns for Java EE began to take shape (http://java.sun.com/blueprints/patterns). Frameworks such as Struts and Avalon gave more formal structure to web applications, and best practices began to emerge from, and inform, these frameworks. Spring's framework expanded on the concepts introduced in Struts and Avalon, adding its own twist in the form of its extremely lightweight Inversion of Control (IoC) container. Spring is different from other frameworks in that it can be used with virtually any Java component, including POJOs (Plain Old Java Objects), and can be leveraged in small pieces.

This chapter is about the Big Picture. We will explore the core concepts behind Spring and what it brings to Java EE Object Oriented methodologies. We'll also briefly summarize some of the other features of Spring that exist outside of the IoC container and illustrate how these features fit together, and tease apart.

What makes a framework, work?

A framework is essentially a skeleton, a structure around which the fleshing out of your application occurs. Frameworks tend to be built around a design pattern and consist of frozen spots -- structural components which are unmodified by the developer -- and hot spots, the pieces that an application developer contributes\(^2\). In Spring, the

---

\(^1\) A 1950's horror film featuring the big screen debut of Steve McQueen. The film stars an ever-growing, all-consuming amoeba-like monster that terrorizes a small Pennsylvania town.

---

Spring by Example Version 1.3

Spring by Example
hot spots are developer-contributed POJOs which are configured to run within the framework.

In this chapter we'll explore the context of Spring's most important component – the IoC container – and how Spring can lead you to better Object Oriented programming and eventually to new possibilities with Aspect Oriented Programming. The Spring framework can't make bad code good, but it can enforce good coding practices that make it easier for you and your fellow developers to cooperate in writing well-factored, reusable, readable, and manageable application components.

1. Spring and Inversion of Control

There is a lot of confusion about the definition of the IoC container – some equate it with a design pattern called Dependency Injection – but in reality IoC is much larger than dependency injection. The Spring IoC container enforces dependency injection in its various forms and employs a number of established design patterns to achieve this.

The main idea behind Inversion of Control as a concept is that component dependencies, lifecycle events, and configuration reside outside of the components themselves, and in the case of Spring, in the framework. This may sound a bit like giving up too much control, but in fact it can make your code more manageable, more testable, and more portable.

Before we discuss the Spring IoC container in detail, it's important to understand on the most basic level what the dependency injection pattern is and how it emerged in object oriented programming methodology. Spring's Inversion of Control framework is based on some best practice patterns – aspects of Spring IoC resemble and include the Factory and Observer patterns, and its most prominent feature is its implementation of a framework which enforces use of the dependency injection pattern.

Dependency Inversion: Precursor to Dependency Injection

The first reference to what would eventually become Dependency Injection appeared in 1994 in a paper by Robert C. Martin called “The Dependency Inversion Principle”.

In “The Dependency Inversion Principle” (or DIP), the author states the three defining factors of “bad code”:

1. It is hard to change because every change affects too many other parts of the system (Rigidity)
2. When you make a change, unexpected parts of the system break (Fragility)
3. It is hard to reuse in another application because it cannot be disentangled from the current application (Immobility) ³

According to Martin, interdependency causes these coding problems (we'll call them RFI for Rigidity, Fragility, and Immobility). To fix RFI issues in your OO code, DIP has two basic rules:

1. High level modules should not depend upon low level modules, both should depend upon abstractions.

In other words, high level modules – which contain your business logic and all of the important meat of your

---

³ The Dependency Inversion Principle, Martin, Robert C., c 1994
application – should not depend on lower level components. The reason for this is if these lower level components were to change, the changes might affect the higher level components as well. This is the defining concept behind dependency inversion, that the prevailing wisdom of having higher-level modules dependent on lower-level modules is in fact a bad idea.

2. *Abstractions should not depend upon details, details should depend upon abstractions.*

This is another way to say that before you begin coding to the abstraction – the interface or abstract class -- you should find the common behaviors in the code and work backwards. Your interface / abstraction should cater to the intersection between the needs of your business logic and the common behaviors of the lower level modules. You should also leave the details of how these behaviors are implemented to the implementation classes.

This simple example of a voting booth program shows a non-DIP compliant program.

```java
package org.springbyexample.vote;

public class VotingBooth {
    VoteRecorder voteRecorder = new VoteRecorder();
    public void vote(Candidate candidate) {
        voteRecorder.record(candidate);
    }

    class VoteRecorder {
        Map hVotes = new HashMap();
        public void record(Candidate candidate) {
            int count = 0;
            if (!hVotes.containsKey(candidate)) {
                hVotes.put(candidate, count);
            } else {
                count = hVotes.get(candidate);
            }

            count++;
            hVotes.put(candidate, count);
        }
    }
}
```

1. This increments the `count` variable.
2. Add candidate and votes to `Map`.

In this example, the `VotingBooth` class is directly dependent on `VoteRecorder`, which has no abstractions and is the implementing class.

A dependency “inverted” version of this code might look a little different. First, we would define our `VoteRecorder` interface.
And our implementing classes.

The LocalVoteRecorder, which implements the VoteRecorder interface:

```
package org.springbyexample.vote;

public class LocalVoteRecorder implements VoteRecorder {
    Map hVotes = new HashMap();
    
    public void record(Candidate candidate) {
        int count = 0;
        if (!hVotes.containsKey(candidate)){
            hVotes.put(candidate, count);
        } else {
            count = hVotes.get(candidate);
        }
        count++;
        hVotes.put(candidate, count);
    }
}
```

And the VotingBooth class:

```
package org.springbyexample.vote;

public class VotingBooth {
    VoteRecorder recorder = null;

    public void setVoteRecorder(VoteRecorder recorder) {
        this.recorder = recorder;
    }

    public void vote(Candidate candidate) {
        recorder.record(candidate);
    }
}
```
Now the LocalVoteRecorder class – the implementing class of the VoteRecorder interface -- is completely decoupled from the VotingBooth class. We have removed all hard-coded references to lower level classes. According to the rules of DIP, this is all we need to do in order to rid our code of RFI.

However, there is one problem with this implementation. We don’t have a main method. We definitely need one in order to run our application, and somewhere in this main method we will need to instantiate the LocalVoteRecorder.

By instantiating the LocalVoteRecorder in our main method, we would break Rule #1 of Dependency Inversion. We have coded to the abstraction, we have integrated our changes, but our application would still have a dependency on a lower level class.

### 2. Dependency Injection To The Rescue

Dependency Injection takes the level of decoupling that began with the Dependency Inversion Principle one step further. Dependency injection has the concept of an assembler -- or what in Java is commonly referred to as a Factory -- that instantiates the objects required by an application and “injects” them into their dependent objects.

In the case of a dependency injection-informed framework such as Spring, components are coded to interfaces, just as in the DIP example above. But now the IoC container manages the instantiation, management, and class casting of the implemented objects so that the application doesn't have to. This removes any true dependencies on low-level implemented classes.

There are three types of Dependency Injection employed by IoC container providers.

**Table 1. Dependency Injection Types**

<table>
<thead>
<tr>
<th>DI Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constructor Injection</td>
<td>The constructor arguments are injected during instance instantiation.</td>
</tr>
<tr>
<td>Setter Injection</td>
<td>This is the most favored method of dependency injection in Spring. Dependencies are “set” in the objects through setter methods defined in a Spring configuration file.</td>
</tr>
<tr>
<td>Interface Injection</td>
<td>This is not implemented in Spring currently, but by Avalon. It’s a different type of DI that involves mapping items to inject to specific interfaces.</td>
</tr>
</tbody>
</table>

Spring uses the concept of a BeanFactory as its assembler, and it is the BeanFactory that manages the JavaBeans you have configured to run within it. In the next section we will discuss Spring's IoC container and how it makes use of dependency injection patterns to make your code, well, RFI-free, and just better.

---

4 Martin Fowler, *Inversion of Control Containers and The Dependency Injection Pattern*
3. Bean management through IoC

Through its factory, Spring's IoC container manages the objects that it is configured to instantiate. Spring's management of the container objects adds flexibility and control to your application, and provides a central place of configuration management for your Plain Old Java Objects.

For example, through Spring IoC you can configure the number of instances of the component – whether the component is a singleton or not – and at what point the component is created and destroyed in memory. In Spring, the initialization of a bean by the framework is exactly equivalent to using the `new` keyword to instantiate an object in Java code. Once the framework has instantiated the object, it manages the scope of the bean, based on its configuration.

Because the IoC container is managing the beans, JNDI lookups that are typical in Java EE containers are no longer required, leaving your code container-agnostic and easier to unit test both inside and outside of the framework. And while you are coding to interfaces as part of good OO practice, Spring allows you to manage what implementations are used by leveraging dependency injection, resulting in cleaner, decoupled components.

The IoC container can also be configured to receive instantiation and destruction callback events for a particular bean. Certain components such as a database connection pool obviously need to be initialized and destroyed when the application is shutdown. Instead of using your custom code, Spring can manage these lifecycle events.

4. Our Example In Spring IoC

So how would we configure our simple voting counter example for the Spring IoC container?

We can use our code exactly as is. All we need to do is inform Spring through an XML configuration file that the `recorder` bean is implemented by the `LocalVoteRecorder` class. We do this with the following line:

```
<bean id="recorder"
     class="com.springindepth.LocalVoteRecorder" />
```

Then we simply map the `recorder` bean to the `VotingBooth` bean by setter injection in that beans definition.

```
<bean id="votingBooth"
     class="com.springindepth.VotingBooth">
  <property name="voteRecorder" ref="recorder"/> 
</bean>
```

Spring works its magic to handle class instantiation for you, so your application code never becomes aware of the implementing classes. Now with this configuration and the Spring framework, and through dependency injection, we have finally removed the low-level component dependencies and have achieved true dependency inversion!
A Practical Introduction to Inversion of Control

Susan Kerschbaumer
David Winterfeldt
2009

As we may have mentioned, the core of the Spring Framework is its Inversion of Control (IoC) container. The IoC container manages Java objects – from instantiation to destruction – through its BeanFactory. Java components that are instantiated by the IoC container are called beans, and the IoC container manages a bean's scope, lifecycle events, and any AOP features for which it has been configured and coded.

The IoC container enforces the dependency injection pattern for your components, leaving them loosely coupled and allowing you to code to abstractions. This chapter is a tutorial – in it we will go through the basic steps of creating a bean, configuring it for deployment in Spring, and then unit testing it.

1. Basic Bean Creation

A Spring bean in the IoC container can typically be any POJO (plain old Java object). POJOs in this context are defined simply as reusable modular components – they are complete entities unto themselves and the IoC container will resolve any dependencies they may need. Creating a Spring bean is as simple as coding your POJO and adding a bean configuration element to the Spring XML configuration file or annotating the POJO, although XML based configuration will be covered first.

To start our tutorial, we'll use a simple POJO, a class called Message which does not have an explicit constructor, just a getMessage() and setMessage(String message) method. Message has a zero argument constructor and a default message value.

```java
public class DefaultMessage {
    private String message = "Spring is fun.";

    /**
     * Gets message.
     * @return message
     */
    public String getMessage() {
        return message;
    }

    /**
     * Sets message.
     * @param message
     */
    public void setMessage(String message) {
        this.message = message;
    }

}
```
Example 1 DefaultMessage

The bean element below indicates a bean of type Message – defined by the class attribute – with an id of 'message'. The instance of this bean will be registered in the container with this id.

An end tag for the beans element closes the document (we said it was simple!).

DefaultMessageTest-context.xml

Example: DefaultMessage

<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xsi:schemaLocation="http://www.springframework.org/schema/beans
http://www.springframework.org/schema/beans/spring-beans.xsd">
  <bean id="message"
        class="org.springbyexample.di.xml.DefaultMessage"/>
</beans>

When the container instantiates the message bean, it is equivalent to initializing an object in your code with 'new DefaultMessage()'.

2. Basic Constructor Injection

Now that we have our POJO and a basic configuration for the message bean, we can introduce our first dependency injection example. Through the Spring beans XML file you can configure your bean to initialize with an argument for the constructor, and then assign the arguments. Spring essentially “injects” the argument into your bean. This is referred to as constructor injection.

The following example passes in the String message using a constructor. The class is the same as the one in Basic Bean Creation except the default message on the message variable has been cleared and is now set to null. A single parameter constructor has been added to set a message.

```java
public class ConstructorMessage {
    private String message = null;
    /**
     * Constructor
     */
    public ConstructorMessage(String message) {
        this.message = message;
    }
    /**
     * Gets message.
     */
    public String getMessage() {
        return message;
    }
    /**
```
Example 2 ConstructorMessage

The configuration for this bean is exactly the same as in the previous example, but now we have a new element, the `constructor-arg`. The `constructor-arg` element injects a message into the bean using the `constructor-arg` element’s value attribute.

ConstructorMessageTest-context.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://www.springframework.org/schema/beans
    http://www.springframework.org/schema/beans/spring-beans.xsd">
  <bean id="message" class="org.springbyexample.di.xml.ConstructorMessage">
    <constructor-arg value="Spring is fun." />
  </bean>
</beans>
```

3. Basic Setter Injection

The Spring IoC container also supports setter injection, which is the preferred method of dependency injection in Spring. Setter injection uses the `set*` methods in a class file to garner property names that are configurable in the spring XML config.

From a configuration standpoint, setter injection is easier to read because the property name being set is assigned as an attribute to the bean, along with the value being injected.

To determine the property names, Spring follows the JavaBeans Specification (http://java.sun.com/products/javabeans/docs/spec.html).

In most cases Spring will lowercase the first letter after “set” in the method name and use the rest of the method name as-is for deducing the property name. So for example if there is a `setMessage()` method in your class, the property name you would use when setting that property on a bean in the XML config is 'message'. If there is a `setFirstName()` method in your class, the property name you would use when setting the value is 'firstName'.

In cases where the letters after “set” are all uppercase, Spring will leave the property name as uppercase. So if you have `setXML()` on a class, the property name would be 'XML'.
Because Spring uses the set method names to infer the property name, the naming of your set methods should follow the JavaBeans Spec, or at least be consistent within the confines of your application. See the example below for basic setter injection on our Message class.

```java
public class SetterMessage {
    private String message = null;

    /**
     * Gets message.
     */
    public String getMessage() {
        return message;
    }

    /**
     * Sets message.
     */
    public void setMessage(String message) {
        this.message = message;
    }
}
```

**Example 3 SetterMessage**

The `property` element is used to define the setter injection:

```
SetterMessageTest-context.xml
```

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xsi:schemaLocation="http://www.springframework.org/schema/beans
http://www.springframework.org/schema/beans/spring-beans.xsd">

    <bean id="message" class="org.springbyexample.di.xml.SetterMessage">
        <property name="message" value="Spring is fun."/>
    </bean>

</beans>
```

### 4. Reference Injection

So far we have only injected constructor and property values with static values, which is useful if you want to eliminate configuration files. Values can also be injected by reference -- one bean definition can be injected into another. To do this, you use the `constructor-arg` or `property`'s `ref` attribute instead of the `value` attribute. The `ref` attribute then refers to another bean definition's id.

In the following example, the first bean definition is a `java.lang.String` with the id `springMessage`. It is
Instantiating Spring in your application does not violate rule #1 of dependency inversion (see Spring In Context: Core Concepts) because Spring would be a higher level dependency.

**ReferenceSetterMessageTest-context.xml**

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xsi:schemaLocation="http://www.springframework.org/schema/beans
                          http://www.springframework.org/schema/beans/spring-beans.xsd">

  <bean id="springMessage"
       class="java.lang.String">
    <constructor-arg value="Spring is fun." />
  </bean>

  <bean id="message"
       class="org.springbyexample.di.xml.SetterMessage">
    <property name="message" ref="springMessage" />
  </bean>

</beans>
```

5. Creating a Spring Application

Spring can be used in standard applications, web applications, full Java EE applications, and other containers, the only requirement is that you run a standard JVM. Spring's resource abstraction allows you to load configuration files from wherever you'd like -- the classpath, the file system, FTP, and HTTP locations. You can also use Spring's resource abstraction for loading other files required for your application.

Once the IoC container is initialized, you can retrieve your Spring beans. By delegating as much bean creation as possible to Spring, there should only be a few key points where the application code needs to directly access the IoC container, and this is true even for legacy applications.⁰ If you're developing a web application, you may not need to directly access the IoC container at all since it will automatically handle instantiation of your controller and any beans it requires.

The lowest level implementation of the IoC container is the BeanFactory, but it is recommended to use an ApplicationContext for your application. The ApplicationContext is a subclass of the BeanFactory interface so it has all the functionality a BeanFactory has and more. Unless you are writing an application that needs an extremely small memory footprint, BeanFactory shouldn't be used directly.

There are a few different ApplicationContext implementations that can be used, which can be learned about by reading the Spring Framework's documentation and source code. For the purposes of this example, we'll use a very popular one -- ClassPathXmlApplicationContext, which defaults to reading resources from the classpath. If you need to use a different location for your classes, you can append prefixes before the configuration file's path such as 'file', 'http', etc. This will force the ApplicationContext to read from somewhere other than the default location.

The following class is a standard Java application with a main method. The first line of the main method creates a

---

⁰ Instantiating Spring in your application does not violate rule #1 of dependency inversion (see Spring In Context: Core Concepts) because Spring would be a higher level dependency.
ClassPathXmlApplicationContext passing in '/application-context.xml' to its constructor which is assigned to the ApplicationContext interface. In this case the configuration file is in the root of the classpath. The ApplicationContext's `getBean(String beanName)` method is used on the next line to retrieve the message bean from the IoC container.

```java
public class MessageRunner {
    final static Logger logger = LoggerFactory.getLogger(MessageRunner.class);

    /**
     * Main method.
     *
     * @param args
     */
    public static void main(String[] args) {
        logger.info("Initializing Spring context.");
        ApplicationContext applicationContext = new ClassPathXmlApplicationContext("/application-context.xml");
        logger.info("Spring context initialized.");
        Message message = (Message) applicationContext.getBean("message");
        logger.debug("message='" + message.getMessage() + "'");
    }
}
```

**Example 4 MessageRunner**

**application-context.xml**

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xsi:schemaLocation="http://www.springframework.org/schema/beans
                          http://www.springframework.org/schema/beans/spring-beans.xsd">
    <bean id="message" class="org.springbyexample.di.app.Message">
        <property name="message" value="Spring is fun." />
    </bean>
</beans>
```

### 6. Unit Test Beans from Application Context

There are two types of testing that developers typically perform before they release code into production. Functional testing is the testing you do when your application is mostly built and you want to make sure that everything works according to the functional requirements you were given.

**Unit testing** is the process by which you test each component of your application in isolation. Unit testing can be done far in advance of functional testing and code release. EJBs are difficult to unit test because it is cumbersome to
tease them apart from the container for testing. Spring makes unit testing easy because each component is intended to be an entity unto itself—callable from anywhere.

Unit testing is an important part of the development process, so important in fact that some methodologies, including Agile\(^2\), require that the unit test be written before the class that it will be testing. Certainly writing the unit test first will give you a very clear idea of the use case for your class file. But the real value in unit testing is in giving you the ability to isolate where the problems may lie in your code. This will shorten the amount of time you would need to debug your code and ultimately lead to faster time to production.

As you create your unit tests, you may organize them into test suites. There are several third party and open source products that can help you set up and conduct your unit tests. JUnit (http://www.junit.org) is the most popular unit testing framework and can be integrated with Ant, Maven, the Eclipse IDE, and others. Maven (http://maven.apache.org) is a build framework used for compiling, assembling jars, and running unit tests. All of the examples that accompany this book can be built and tested using Maven, and Eclipse plugins for Junit allow you to run your unit tests from within the IDE.

Spring also has unit testing support and it can reduce the size of your test classes if you can use them. Most unit tests are annotated with @RunWith(SpringJUnit4ClassRunner.class) and @ContextConfiguration. The @ContextConfiguration default to loading an XML configuration file from the package and name of the test plus ‘-context.xml’. For org.springframework.di.xml.SetterMessageTest, the default XML file is org/springbyexample/di/xml/SetterMessageTest-context.xml. Specific XML configuration files can be set on the annotation if the default isn’t acceptable.

The SetterMessageTest will use the Spring XML configuration file org/springbyexample/di/xml/SetterMessageTest-context.xml. The testMessage() method uses the SetterMessage injected by the test framework into the message field. The bean from the XML configuration will be injected into this field because of the @Autowired annotation which indicates the field should be autowired by type. Finally, the testMessage() method uses JUnit’s assertNull and assertEquals methods to check if the SetterMessageTest instance isn’t null, the message isn’t null, and the message is the expected value. For assertEquals the first parameter is the error message that will be shown if the test fails. The second parameter is the expected value and third parameter is the value from the message bean.

```java
@RunWith(SpringJUnit4ClassRunner.class)
@ContextConfiguration
public class SetterMessageTest {
    final Logger logger = LoggerFactory.getLogger(SetterMessageTest.class);

    @Autowired
    private SetterMessage message = null;

    /**
     * Tests message.
     */
    @Test
    public void testMessage() {
        assertNotNull("Constructor message instance is null.", message);
        String msg = message.getMessage();
        assertNotNull("Message is null.", msg);
        String expectedMessage = "Spring is fun.";
        assertEquals(expectedMessage, msg);
    }
}
```

\(^{2}\) A conceptual framework that promotes development iterations throughout the lifecycle of a project.
Example 5 SetterMessageTest

SetterMessageTest-context.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xsi:schemaLocation="http://www.springframework.org/schema/beans
                         http://www.springframework.org/schema/beans/spring-beans.xsd">
  <bean id="message"
        class="org.springbyexample.di.xml.SetterMessage">
    <property name="message" value="Spring is fun." />
  </bean>
</beans>
```

7. Getting Started

Now that we've walked you through the creation and testing of your first Spring application, it's time to dig a little deeper into Spring. Articles and examples will cover different areas of the Spring Framework and other Spring projects. Before we do, use the following instructions to set up your Spring environment, and check out these basic DI examples.

Setup

Follow the Project Checkout instructions for git, then go to the project (relative path below).

```bash
$ cd core/basic-dependency-injection
```

General Setup Instructions

General instructions for checking out the project with Eclipse and building with Maven.

Example Project Setup

8. Reference
Related Links

- Spring 3.2.x 'The IoC Container' Documentation
  [http://static.springsource.org/spring/docs/3.2.x/spring-framework-reference/html/beans.html#beans-introduction]

Project Information

- Spring Framework 3.2.x
Part II. Core

Core Spring examples.
AspectJ Load-time Weaving in Spring

David Winterfeldt

2008

This example shows using Spring with AspectJ's Load-time Weaving (LTW) to gather statistics. Spring 2.5 added support to make it easier to use AspectJ's LTW. It's also finer grained because you can activate it in specific classloaders using the new context namespace by adding this, <context:load-time-weaver />, to your XML configuration. Besides adding a JVM argument and the custom namespace, the rest is standard AspectJ LTW and how to configure the AspectJ configuration file can be found on AspectJ's site.

Note

This example must be run with Java 5 or higher since support for the -javaagent JVM argument was added in Java 5. Also, Maven and Eclipse are currently configured to look for the spring-agent.jar at c:/spring-framework-2.5/dist/weaving/spring-agent.jar so you will need to edit this to match where it is actually located. This can be changed at the bottom of the Maven pom.xml or in the Eclipse Run Dialog's argument tab.

1. JVM Argument

This JVM argument needs to be set in order for Spring's context:load-time-weaver to work, although with certain classloaders this isn't necessary.

```
-javaagent:/path/to/jar/spring-agent.jar
```

2. Spring Configuration

The context:load-time-weaver registers AspectJ's Load-time Weaver to the current classloader. So, not only Spring beans will be targeted, but any class loaded in the classloader that match the defined pointcuts.

```
<applicationContext.xml

<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
     xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
     xmlns:context="http://www.springframework.org/schema/context"
     xsi:schemaLocation="http://www.springframework.org/schema/beans
     http://www.springframework.org/schema/beans/spring-beans.xsd
     http://www.springframework.org/schema/context
     http://www.springframework.org/schema/context/spring-context.xsd">

<context:load-time-weaver />
```
3. AspectJ Configuration

For AspectJ LTW a configuration file will automatically be loaded from META-INF/aop.xml. Multiple includes or
excludes can be used to target weaving, and if you wanted to include all subpackages and not just a specific package
the package name could be specified as org.springbyexample.aspectjLoadTimeWeaving..* (notice
the double periods before the asterisk). In this example, the aspect specified contains the pointcut and advice being
applied.

/META-INF/aop.xml

4. Code Example

```java
@Aspect
public class PerformanceAdvice {
    @Pointcut("execution(public * org.springbyexample.aspectjLoadTimeWeaving..*\(\..\))")
    public void aspectjLoadTimeWeavingExamples() {
    }

    @Around("aspectjLoadTimeWeavingExamples()")
    public Object profile(ProceedingJoinPoint pjp) throws Throwable {
        final Logger logger = LoggerFactory.getLogger(pjp.getSignature().getDeclaringType());
        StopWatch sw = new StopWatch(getClass().getSimpleName());

        try {
            sw.start(pjp.getSignature().getName());
            return pjp.proceed();
        } finally {
            sw.stop();
        }
    }
}
```
logger.debug(sw.prettyPrint());
}
}

Example 1 PerformanceAdvice

5. Reference

Related Links


Project Setup

Follow the Project Checkout instructions for git, then go to the project (relative path below).

$ cd core/aspectj-load-time-weaving

General Setup Instructions

General instructions for checking out the project with Eclipse and building with Maven.

Example Project Setup

Project Information

- Spring Framework 3.2.x
- AspectJ 1.7.x
Part III. Persistence

Persistence examples.
A simple example using SimpleJdbcTemplate.

1. Spring Configuration

The Spring JDBC Template just needs a DataSource. The jdbc:embedded-database element automatically initializes an HSQL DB DataSource with the schema.sql script.

```xml
<jdbc:embedded-database id="dataSource" type="HSQL">
  <jdbc:script location="classpath:/schema.sql" />
</jdbc:embedded-database>
```

2. Code Example

Inject the DataSource into a bean and in the setter for the DataSource create a SimpleJdbcTemplate. Then the template has many methods for doing updates, queries, and deletes. The example below shows getting a List of Maps from the template.

```java
protected SimpleJdbcTemplate simpleJdbcTemplate = null;

@Autowired
public void setDataSource(final DataSource dataSource) {
  this.simpleJdbcTemplate = new SimpleJdbcTemplate(dataSource);
}

List<Map<String, Object>> lPersonMaps = simpleJdbcTemplate.queryForList("SELECT * FROM PERSON");
Map<String, Object> hPerson = lPersonMaps.get(0);
Integer id = (Integer)hPerson.get("ID");
String firstName = (String)hPerson.get("FIRST_NAME");
String lastName = (String)hPerson.get("LAST_NAME");
```

3. Reference
Related Links

- Spring 3.2.x SimpleJdbcTemplate Documentation
  [http://static.springsource.org/spring/docs/3.2.x/spring-framework-reference/html/jdbc.html#jdbc-SimpleJdbcTemplate]

- Spring 3.2.x JDBC Custom Namespace
Simple Hibernate XML Configuration

David Winterfeldt

2008

A simple example using Hibernate with an XML configuration to find, save, and update a record.

1. Spring Configuration

The `jdbc:embedded-database` element is used to initialize the test HSQLDB database and the `LocalSessionFactoryBean` is using to configure Hibernate. The `mappingLocations` property is used to set a list of Hibernate XML mapping files. The Person DAO is configured using Hibernate's session factory.

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:p="http://www.springframework.org/schema/p"
    xmlns:jdbc="http://www.springframework.org/schema/jdbc"
    xsi:schemaLocation="http://www.springframework.org/schema/beans
    http://www.springframework.org/schema/beans/spring-beans.xsd
    http://www.springframework.org/schema/jdbc
    http://www.springframework.org/schema/jdbc/spring-jdbc.xsd">
    <jdbc:embedded-database id="dataSource" type="HSQL">
        <jdbc:script location="classpath:/schema.sql" />
    </jdbc:embedded-database>
    <bean id="sessionFactory"
        class="org.springframework.orm.hibernate3.LocalSessionFactoryBean"
        p:datasource-ref="dataSource">
        <property name="mappingLocations">
            <list>
                <value>classpath:org/springbyexample/orm/hibernate3/bean/Address.hbm.xml</value>
                <value>classpath:org/springbyexample/orm/hibernate3/bean/Person.hbm.xml</value>
            </list>
        </property>
        <property name="hibernateProperties">
            <value>
                hibernate.format_sql=true
                hibernate.dialect=org.hibernate.dialect.HSQLDialect
            </value>
        </property>
    </bean>
</beans>
```

2. Hibernate Configuration

A very simple Hibernate configuration mapping the PERSON table to the Person class.
3. SQL Script

```sql
CREATE TABLE PERSON (
  ID INTEGER generated by default as identity (start with 1) not null,
  FIRST_NAME varchar(50) not null,
  LAST_NAME varchar(50) not null
);
```

4. Code Example

The Hibernate SessionFactory is used to create a HibernateTemplate as it's set. The template is then used for any Hibernate database operations. Spring's HibernateTemplate converts all exceptions to runtime exceptions so it isn't necessary to handle any exceptions.

```java
@Repository
public class PersonDaoImpl implements PersonDao {

  protected HibernateTemplate template = null;

  /**
   * Sets Hibernate session factory and creates a <code>HibernateTemplate</code> from it.
   */
  public void setSessionFactory(SessionFactory sessionFactory) {
    template = new HibernateTemplate(sessionFactory);
  }

  /**
   * Find all persons.
   */
```
5. Reference

Related Links

- Spring 3.2.x Hibernate Documentation [http://static.springsource.org/spring/docs/3.2.x/spring-framework-reference/html/orm.html#orm-hibernate]
- Spring 3.2.x JDBC Custom Namespace [http://static.springsource.org/spring/docs/3.2.x/spring-framework-reference/html/jdbc.html#jdbc-embedded-database-support]
- Hibernate [http://www.hibernate.org/]
- Apache Commons DBCP [http://commons.apache.org/dbcp]
One to Many Hibernate XML Configuration

David Winterfeldt

2008

A simple example using a one-to-many relationship in Hibernate with an XML configuration to find, save, and update a record. A Person has a one-to-many relationship with Address.

1. Spring Configuration

The `<jdbc:embedded-database>` element is used to initialize the test HSQLDB database and the `LocalSessionFactoryBean` is used to configure Hibernate. The `mappingLocations` property is used to set a list of Hibernate XML mapping files. The Person DAO is configured using Hibernate's session factory.

`shared-context.xml`

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:p="http://www.springframework.org/schema/p"
  xmlns:jdbc="http://www.springframework.org/schema/jdbc"
  xsi:schemaLocation="http://www.springframework.org/schema/beans
  http://www.springframework.org/schema/beans/spring-beans.xsd
  http://www.springframework.org/schema/jdbc
  http://www.springframework.org/schema/jdbc/spring-jdbc.xsd">
  <jdbc:embedded-database id="dataSource" type="HSQL">
    <jdbc:script location="classpath:/schema.sql" />
  </jdbc:embedded-database>

  <bean id="sessionFactory" class="org.springframework.orm.hibernate3.LocalSessionFactoryBean">
    <property name="mappingLocations">
      <list>
        <value>classpath:org/springbyexample/orm/hibernate3/bean/Address.hbm.xml</value>
        <value>classpath:org/springbyexample/orm/hibernate3/bean/Person.hbm.xml</value>
      </list>
    </property>
    <property name="hibernateProperties">
      <value>
        hibernate.format_sql=true
        hibernate.dialect=org.hibernate.dialect.HSQLDialect
      </value>
    </property>
  </bean>
</beans>
```
PersonDaoTest-context.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xmlns:p="http://www.springframework.org/schema/p"
   xsi:schemaLocation="http://www.springframework.org/schema/beans
   http://www.springframework.org/schema/beans/spring-beans.xsd">
   <import resource="classpath:org/springbyexample/orm/hibernate3/shared-context.xml"/>

   <bean id="personDao"
       class="org.springbyexample.orm.hibernate3.dao.PersonDaoImpl"
       p:sessionFactory-ref="sessionFactory" />
</beans>
```

2. Hibernate Configuration

A very simple Hibernate configuration mapping the PERSON table to the Person class and the ADDRESS table to the Address class. There is a one-to-many relationship between the PERSON and ADDRESS table. The set element in the Person mapping creates the relationship from the PERSON to the ADDRESS table and stores the Address instances in a java.util.Set. The key element inside the set element indicates ADDRESS.PERSON_ID is the column to match against PERSON.ID to retrieve addresses associated with a person.

Person.hbm.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE hibernate-mapping PUBLIC
   "-//Hibernate/Hibernate Mapping DTD 3.0//EN"
   "http://hibernate.sourceforge.net/hibernate-mapping-3.0.dtd">

<hibernate-mapping package="org.springbyexample.orm.hibernate3.bean" default-access="field">
   <class name="Person" table="PERSON">
       <id name="id" column="ID">
           <generator class="native"/>
       </id>
       <property name="firstName" column="FIRST_NAME" />
       <property name="lastName" column="LAST_NAME" />
       <set name="addresses" lazy="false" inverse="false">
           <key column="PERSON_ID"/>
           <one-to-many class="Address"/>
       </set>
       <property name="created" column="CREATED" />
   </class>
</hibernate-mapping>
```

Address.hbm.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE hibernate-mapping PUBLIC
   "-//Hibernate/Hibernate Mapping DTD 3.0//EN"
   "http://hibernate.sourceforge.net/hibernate-mapping-3.0.dtd">

<hibernate-mapping package="org.springbyexample.orm.hibernate3.bean" default-access="field">
   <class name="Address" table="ADDRESS">
       <id name="id" column="ID">...
   </class>
</hibernate-mapping>
```
3. SQL Script

Excerpt from schema.sql

```sql
CREATE TABLE PERSON (
    ID integer identity primary key,
    FIRST_NAME varchar(50) not null,
    LAST_NAME varchar(50) not null,
    CREATED timestamp,
    CONSTRAINT IDX_PERSON_ID PRIMARY KEY (ID)
);

CREATE TABLE ADDRESS (
    ID integer identity primary key,
    PERSON_ID integer,
    ADDRESS varchar(255),
    CITY varchar(50) not null,
    STATE varchar(50) not null,
    ZIP_POSTAL varchar(30) not null,
    CREATED timestamp,
    CONSTRAINT IDX_ADDRESS_ID PRIMARY KEY (ID),
    CONSTRAINT FK_ADDRESS_PERSON_ID FOREIGN KEY (PERSON_ID) REFERENCES PERSON(ID) on delete cascade
);
```

4. Code Example

The Hibernate SessionFactory is used to create a HibernateTemplate as it's set. The template is then used for any Hibernate database operations. Spring's HibernateTemplate converts all exceptions to runtime exceptions so it isn't necessary to handle any exceptions.
The `@Transactional` annotation isn't used in this example because there isn't anything configuring transactions in the Spring configuration.

```java
@Repository
@Transactiona1(readOnly = true)
public class PersonDaoImpl implements PersonDao {

  protected HibernateTemplate template = null;

  /**
   * Sets Hibernate session factory.
   */
  public void setSessionFactory(SessionFactory sessionFactory) {
    template = new HibernateTemplate(sessionFactory);
  }

  /**
   * Find persons.
   */
  @SuppressWarnings("unchecked")
  public Collection<Person> findPersons() throws DataAccessException {
    return template.find("from Person");
  }

  /**
   * Find persons by last name.
   */
  @SuppressWarnings("unchecked")
  public Collection<Person> findPersonsByLastName(String lastName) throws DataAccessException {
    return template.find("from Person p where p.lastName = ?", lastName);
  }

  /**
   * Saves person.
   */
  @Transactional(readOnly = false, propagation = Propagation.REQUIRES_NEW)
  public void save(Person person) {
    template.saveOrUpdate(person);
  }
}
```

*Example 1 PersonDaoImpl*

5. Reference

Related Links

- Spring 3.2.x Hibernate Documentation [http://static.springsource.org/spring/docs/3.2.x/spring-framework-reference/html/orm.html#orm-hibernate]
- Spring 3.2.x JDBC Custom Namespace [http://static.springsource.org/spring/docs/3.2.x/spring-framework-reference/html/jdbc.html#jdbc-embedded-database-support]
- Hibernate [http://www.hibernate.org/]
- Apache Commons DBCP [http://commons.apache.org/dbcp]
• One to Many Hibernate Annotation Configuration

**Project Setup**

Follow the Project Checkout instructions for git, then go to the project (relative path below).

```
$ cd persistence/simple-hibernate
```

**General Setup Instructions**

General instructions for checking out the project with Eclipse and building with Maven.

Example Project Setup

**Project Information**

• Spring Framework 3.2.x

• Hibernate 3.6.10.Final
One to Many Hibernate Annotation Configuration

David Winterfeldt
2008

A simple example using a one-to-many relationship in Hibernate with an Annotation configuration to find, save, and update a record. A Person has a one-to-many relationship with Address.

1. Spring Configuration

The `jdbc:embedded-database` element is used to initialize the test HSQLDB database and the `LocalSessionFactoryBean` is used to configure Hibernate.

```
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:p="http://www.springframework.org/schema/p"
    xmlns:jdbc="http://www.springframework.org/schema/jdbc"
    xsi:schemaLocation="http://www.springframework.org/schema/beans
        http://www.springframework.org/schema/beans/spring-beans.xsd
        http://www.springframework.org/schema/jdbc
        http://www.springframework.org/schema/jdbc/spring-jdbc.xsd">
    <jdbc:embedded-database id="dataSource" type="HSQL">
        <jdbc:script location="classpath:/schema.sql" />
    </jdbc:embedded-database>
    <bean id="sessionFactory" class="org.springframework.orm.hibernate3.LocalSessionFactoryBean">
        <property name="mappingLocations">
            <list>
                <value>classpath:org/springbyexample/orm/hibernate3/bean/Address.hbm.xml</value>
                <value>classpath:org/springbyexample/orm/hibernate3/bean/Person.hbm.xml</value>
            </list>
        </property>
        <property name="hibernateProperties">
            <value>
                hibernate.format_sql=true
                hibernate.dialect=org.hibernate.dialect.HSQLDialect
            </value>
        </property>
    </bean>
</beans>
```

The `annotatedClasses` property is used to set a list of Hibernate annotated classes. The Person DAO is configured using Hibernate's session factory.
2. Hibernate Configuration

The @Entity annotation indicates that the JavaBean is a persistent entity. By default the class name will be used for the Hibernate entity name as this class is registered with Hibernate. A different entity name could be specified by using the annotations name attribute (ex: @Entity(name="Employee")). An @Table annotation can explicitly configure which table the entity is mapped to, although in this case it isn’t necessary since it would default to the name of the class which matches the table name.

The one-to-many relationship from Person to Address is configured on public Set<Address> getAddresses(). The @OneToMany(fetch=FetchType.EAGER) annotation indicates a one-to-many relationship and that any associated addresses should be eagerly fetched. The @JoinColumn(name="PERSON_ID", nullable=false) annotation indicates ADDRESS.PERSON_ID is the column to match against PERSON.ID to retrieve addresses associated with a person.

```java
@Entity
public class Person {
    private Integer id = null;
    private String firstName = null;
    private String lastName = null;
    // Other fields and methods...
}
```
private Set<Address> addresses = null;
private Date created = null;

/**
 * Gets id (primary key).
 */
@Id
@GeneratedValue(strategy=GenerationType.AUTO)
public Integer getId() {
    return id;
}

/**
 * Sets id (primary key).
 */
public void setId(Integer id) {
    this.id = id;
}

/**
 * Gets first name.
 */
@Column(name="FIRST_NAME")
public String getFirstName() {
    return firstName;
}

/**
 * Sets first name.
 */
public void setFirstName(String firstName) {
    this.firstName = firstName;
}

/**
 * Gets last name.
 */
@Column(name="LAST_NAME")
public String getLastName() {
    return lastName;
}

/**
 * Sets last name.
 */
public void setLastName(String lastName) {
    this.lastName = lastName;
}

/**
 * Gets list of <code>Address</code>es.
 */
@OneToMany(fetch=FetchType.EAGER)
@JoinColumn(name="PERSON_ID", nullable=false)
public Set<Address> getAddresses() {
    return addresses;
}

/**
 * Sets list of <code>Address</code>es.
 */
public void setAddresses(Set<Address> addresses) {
    this.addresses = addresses;
}

/**
 * Gets date created.
 */
public Date getCreated() {
    return created;
}
```java
/**
 * Sets date created.
 */
public void setCreated(Date created) {
    this.created = created;
}
...
}

Example 1 Excerpt from Person

@Entity
public class Address {
    private Integer id = null;
    private String address = null;
    private String city = null;
    private String state = null;
    private String zipPostal = null;
    private Date created = null;

    /**
     * Gets id (primary key).
     */
    @Id
    @GeneratedValue(strategy=GenerationType.AUTO)
    public Integer getId() {
        return id;
    }

    /**
     * Sets id (primary key).
     */
    public void setId(Integer id) {
        this.id = id;
    }

    /**
     * Gets address.
     */
    public String getAddress() {
        return address;
    }

    /**
     * Sets address.
     */
    public void setAddress(String address) {
        this.address = address;
    }

    /**
     * Gets city.
     */
    public String getCity() {
        return city;
    }

    /**
     */
```
```java
* Sets city.
*/
public void setCity(String city) {
    this.city = city;
}

/**
 * Gets state.
 */
public String getState() {
    return state;
}

/**
 * Sets state.
 */
public void setState(String state) {
    this.state = state;
}

/**
 * Gets zip or postal code.
 */
@Column(name="ZIP_POSTAL")
public String getZipPostal() {
    return zipPostal;
}

/**
 * Sets zip or postal code.
 */
public void setZipPostal(String zipPostal) {
    this.zipPostal = zipPostal;
}

/**
 * Gets date created.
 */
public Date getCreated() {
    return created;
}

/**
 * Sets date created.
 */
public void setCreated(Date created) {
    this.created = created;
}

...
4. Code Example

The Hibernate SessionFactory is used to create a HibernateTemplate as it's set. The template is then used for any Hibernate database operations. Spring's HibernateTemplate converts all exceptions to runtime exceptions so it isn't necessary to handle any exceptions.

The @Transactional annotation isn't used in this example because there isn't anything configuring transactions in the Spring configuration.

```java
@Repository
@Transactional(readOnly = true)
public class PersonDaoImpl implements PersonDao {

    protected HibernateTemplate template = null;

    /**
     * Sets Hibernate session factory.
     */
    public void setSessionFactory(SessionFactory sessionFactory) {
        template = new HibernateTemplate(sessionFactory);
    }

    /**
     * Find persons.
     */
    @SuppressWarnings("unchecked")
    public Collection<Person> findPersons() throws DataAccessException {
        return template.find("from Person");
    }

    /**
     * Find persons by last name.
     */
    @SuppressWarnings("unchecked")
    public Collection<Person> findPersonsByLastName(String lastName) throws DataAccessException {
        return template.find("from Person p where p.lastName = ?", lastName);
    }

    /**
     * Saves person.
     */
    @Transactional(readOnly = false, propagation = Propagation.REQUIRES_NEW)
    public void save(Person person) {
        template.saveOrUpdate(person);
    }
```
5. Reference

Related Links

- Spring 3.2.x Hibernate Documentation [http://static.springsource.org/spring/docs/3.2.x/spring-framework-reference/html/orm.html#orm-.hibernate]
- Spring 3.2.x JDBC Custom Namespace [http://static.springsource.org/spring/docs/3.2.x/spring-framework-reference/html/jdbc.html#jdbc-embedded-database-support]
- Hibernate [http://www.hibernate.org/]
- Apache Commons DBCP [http://commons.apache.org/dbcp]
- One to Many Hibernate XML Configuration

Project Setup

Follow the Project Checkout instructions for git, then go to the project (relative path below).

```bash
$ cd persistence/simple-hibernate
```

General Setup Instructions

General instructions for checking out the project with Eclipse and building with Maven.

Example Project Setup

Project Information

- Spring Framework 3.2.x
- Hibernate 3.6.10.Final
One to Many JpaTemplate Hibernate Configuration

David Winterfeldt

2009

This is a one-to-many JpaTemplate example using Hibernate that can to find, save, and update a record. There is a Person that has a one-to-many relationship to Address. This example is very similar to One to Many Hibernate Annotation Configuration example since that example was already using javax.persistence annotations to configure the Person and Address beans. Using JpaTemplate can make an easier upgrade path to JPA from an application already using Spring's HibernateTemplate.

Note

This example has the DAO class extend JpaDaoSupport and uses the JpaTemplate, but Spring recommends the native JPA style of coding.

JpaTemplate mainly exists as a sibling of JdoTemplate and HibernateTemplate, offering the same style for people used to it.

— Spring 3.2.x Classic ORM JPA Documentation

1. Spring Configuration

The Person DAO is configured using context:component-scan. Then tx:annotation-driven will configure transactions on any beans with @Transactional, and just after it the JPA transaction manager is setup. The jdbc:embedded-database element is used to initialize the test HSQLDB database. The LocalContainerEntityManagerFactoryBean is configured with the DataSource and for use with Hibernate as the JPA adapter. It also sets the persistenceUnitName attribute to specify which persistence unit to use for this entity manager (multiple examples use this persistence.xml).

PersonTemplateDaoTest-context.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xmlns:p="http://www.springframework.org/schema/p"
      xmlns:context="http://www.springframework.org/schema/context"
      xmlns:jdbc="http://www.springframework.org/schema/jdbc"
      xmlns:tx="http://www.springframework.org/schema/tx"
      xsi:schemaLocation="http://www.springframework.org/schema/beans
                        http://www.springframework.org/schema/beans/spring-beans.xsd
                        http://www.springframework.org/schema/context
                        http://www.springframework.org/schema/context/spring-context.xsd
                        http://www.springframework.org/schema/jdbc
                        http://www.springframework.org/schema/jdbc/spring-jdbc.xsd
                        http://www.springframework.org/schema/tx
                        http://www.springframework.org/schema/tx/spring-tx.xsd">
2. JPA Entity Configuration

The @Entity annotation indicates that the JavaBean is a persistent entity. JPA would automatically pick up this class except the JPA configuration explicitly registers the classes each persistence unit should handle. An @Table annotation can explicitly configure which table the entity is mapped to, although in this case it isn’t necessary since it would default to the name of the class which matches the table name.

Note

Using the ImprovedNamingStrategy in your JPA persistence.xml can give better translation from camel case classes and field names to standard underscore delimited database names. An example of this is that instead of having to explicitly put @Column(name="FIRST_NAME") on the first name field, it automatically converts the camel case of the field name to use underscores.

The one-to-many relationship from Person to Address is configured on public Set<Address> getAddresses(). The @OneToMany(fetch=FetchType.EAGER) annotation indicates a one-to-many relationship and that any associated addresses should be eagerly fetched. The @JoinColumn(name="PERSON_ID", nullable=false) annotation indicates ADDRESS.PERSON_ID is the column to match against PERSON.ID to retrieve addresses associated with a person.
@Entity
public class Person implements Serializable {

    private static final long serialVersionUID = -8712872385957386182L;

    private Integer id = null;
    private String firstName = null;
    private String lastName = null;
    private Set<Address> addresses = null;
    private Date created = null;

    /**
     * Gets id (primary key).
     */
    @Id
    @GeneratedValue(strategy = GenerationType.AUTO)
    public Integer getId() {
        return id;
    }

    /**
     * Sets id (primary key).
     */
    public void setId(Integer id) {
        this.id = id;
    }

    /**
     * Gets first name.
     */
    public String getFirstName() {
        return firstName;
    }

    /**
     * Sets first name.
     */
    public void setFirstName(String firstName) {
        this.firstName = firstName;
    }

    /**
     * Gets last name.
     */
    public String getLastName() {
        return lastName;
    }

    /**
     * Sets last name.
     */
    public void setLastName(String lastName) {
        this.lastName = lastName;
    }

    /**
     * Gets list of <code>Address</code>s.
     */
    @OneToMany(fetch = FetchType.EAGER, cascade = CascadeType.ALL)
    @JoinColumn(name = "PERSON_ID", nullable = false)
    public Set<Address> getAddresses() {
        return addresses;
    }

    /**
     * Sets list of <code>Address</code>s.
     */
    public void setAddresses(Set<Address> addresses) {
        this.addresses = addresses;
    }
}

One to Many JpaTemplate Hibernate Configuration
Example 1 Excerpt from Person

@Entity
public class Address implements Serializable {

    private static final long serialVersionUID = 7851794269407495684L;

    private Integer id = null;
    private String address = null;
    private String city = null;
    private String state = null;
    private String zipPostal = null;
    private String country = null;
    private Date created = null;

    /**
     * Gets id (primary key).
     * @return id
     */
    @Id
    @GeneratedValue(strategy = GenerationType.AUTO)
    public Integer getId() {
        return id;
    }

    /**
     * Sets id (primary key).
     * @param id
     */
    public void setId(Integer id) {
        this.id = id;
    }

    /**
     * Gets address.
     * @return address
     */
    public String getAddress() {
        return address;
    }

    /**
     * Sets address.
     * @param address
     */
    public void setAddress(String address) {
        this.address = address;
    }

    /**
     * Gets city.
     * @return city
     */
    public String getCity() {
        return city;
    }

    /**
     * Sets city.
     * @param city
     */
    public void setCity(String city) {
        this.city = city;
    }

    /**
     * Gets state.
     * @return state
     */
    public String getState() {
        return state;
    }

    /**
     * Sets state.
     * @param state
     */
    public void setState(String state) {
        this.state = state;
    }

    /**
     * Gets zipPostal.
     * @return zipPostal
     */
    public String getZipPostal() {
        return zipPostal;
    }

    /**
     * Sets zipPostal.
     * @param zipPostal
     */
    public void setZipPostal(String zipPostal) {
        this.zipPostal = zipPostal;
    }

    /**
     * Gets country.
     * @return country
     */
    public String getCountry() {
        return country;
    }

    /**
     * Sets country.
     * @param country
     */
    public void setCountry(String country) {
        this.country = country;
    }

    /**
     * Gets created.
     * @return created
     */
    public Date getCreated() {
        return created;
    }

    /**
     * Sets created.
     * @param created
     */
    public void setCreated(Date created) {
        this.created = created;
    }

    ...
public String getCity() {
    return city;
}

/**
 * Sets city.
 */
public void setCity(String city) {
    this.city = city;
}

/**
 * Gets state.
 */
public String getState() {
    return state;
}

/**
 * Sets state.
 */
public void setState(String state) {
    this.state = state;
}

/**
 * Gets zip or postal code.
 */
public String getZipPostal() {
    return zipPostal;
}

/**
 * Sets zip or postal code.
 */
public void setZipPostal(String zipPostal) {
    this.zipPostal = zipPostal;
}

/**
 * Gets country.
 */
public String getCountry() {
    return country;
}

/**
 * Sets country.
 */
public void setCountry(String country) {
    this.country = country;
}

/**
 * Gets date created.
 */
public Date getCreated() {
    return created;
}

/**
 * Sets date created.
 */
public void setCreated(Date created) {
    this.created = created;
}

...
3. JPA Configuration

Excerpt from META-INF/persistence.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<persistence xmlns="http://java.sun.com/xml/ns/persistence"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://java.sun.com/xml/ns/persistence
    http://java.sun.com/xml/ns/persistence/persistence_2_0.xsd"
    version="2.0">
    <persistence-unit name="simple-jpa-template" transaction-type="RESOURCE_LOCAL">
        <class>org.springbyexample.orm.jpa.bean.Person</class>
        <class>org.springbyexample.orm.jpa.bean.Address</class>
        <exclude-unlisted-classes/>
        <properties>
            <property name="hibernate.dialect" value="org.hibernate.dialect.HSQLDialect"/>
            <property name="hibernate.show_sql" value="true"/>
            <property name="hibernate.hbm2ddl.auto" value="validate"/>
            <property name="hibernate.ejb.naming_strategy" value="org.hibernate.cfg.ImprovedNamingStrategy"/>
            <property name="hibernate.cache.provider_class" value="org.hibernate.cache.HashtableCacheProvider"/>
        </properties>
    </persistence-unit>
    ...
</persistence>
```

4. Code Example

```java
@Repository
@Transactional(readOnly = true)
public class PersonTemplateDaoImpl extends JpaDaoSupport implements PersonTemplateDao {
    /**
     * Constructor
     */
    @Autowired
    public PersonTemplateDaoImpl(EntityManagerFactory entityManagerFactory) {
        super.setEntityManagerFactory(entityManagerFactory);
    }
    /**
     * Find persons.
     */
```
@SuppressWarnings("unchecked")
public Collection<Person> findPersons() {
    return getJpaTemplate().find("from Person");
}

/**
 * Find persons by last name.
 */
@SuppressWarnings("unchecked")
public Collection<Person> findPersonsByLastName(String lastName) {
    return getJpaTemplate().find("from Person p where p.lastName = ?", lastName);
}

/**
 * Saves person.
 */
@Transactional(readOnly = false, propagation = Propagation.REQUIRES_NEW)
public void save(Person person) {
    getJpaTemplate().merge(person);
}

Example 3 PersonTemplateDaoImpl

5. Reference

Related Links

- Spring 3.2.x JPA Documentation [http://static.springsource.org/spring/docs/3.2.x/spring-framework-reference/html/orm.html#orm-jpa]
- Hibernate [http://www.hibernate.org/]
- Spring 3.2.x JDBC Custom Namespace [http://static.springsource.org/spring/docs/3.2.x/spring-framework-reference/html/jdbc.html#jdbc-embedded-database-support]
- Apache Commons DBCP [http://commons.apache.org/dbcp]
- One to Many JPA Hibernate Configuration

Project Setup

Follow the Project Checkout instructions for git, then go to the project (relative path below).

$ cd persistence/simple-jpa

General Setup Instructions

General instructions for checking out the project with Eclipse and building with Maven.
Example Project Setup

**Project Information**

- Spring Framework 3.2.x
- Java Persistence API 2.0
One to Many JPA Hibernate Configuration

David Winterfeldt
2009

This is a one-to-many JPA configuration that can to find, save, and update a record. Hibernate is used as the JPA provider. There is a Person that has a one-to-many relationship to Address. This example is very similar to One to Many JpaTemplate Hibernate Configuration and even uses the same javax.persistence annotated beans, but uses the native JPA style for accessing data objects.

1. Spring Configuration

The Person DAO is configured using context:component-scan. Then tx:annotation-driven will configure transactions on any beans with @Transactional, and just after it the JPA transaction manager is setup. The jdbc:embedded-database element is used to initialize the test HSQLDB database. The LocalContainerEntityManagerFactoryBean is configured with the DataSource and for use with Hibernate as the JPA adapter. It also sets the persistenceUnitName attribute to specify which persistence unit to use for this entity manager (multiple examples use the persistence.xml).

PersonDaoTest-context.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
   xsi:schemaLocation="http://www.springframework.org/schema/beans
   http://www.springframework.org/schema/beans/spring-beans.xsd
   http://www.springframework.org/schema/context
   http://www.springframework.org/schema/context/spring-context.xsd
   http://www.springframework.org/schema/jdbc
   http://www.springframework.org/schema/jdbc/spring-jdbc.xsd
   http://www.springframework.org/schema/tx
   http://www.springframework.org/schema/tx/spring-tx.xsd">

<context:component-scan base-package="org.springbyexample.orm.jpa.dao" />
<tx:annotation-driven />

<bean id="transactionManager"
      class="org.springframework.orm.jpa.JpaTransactionManager"
      p:entityManagerFactory-ref="entityManagerFactory"/>

<jdbc:embedded-database id="dataSource" type="HSQL">
    <jdbc:script location="classpath:/schema.sql" encoding="UTF-8" />
</jdbc:embedded-database>

<bean id="entityManagerFactory"
      class="org.springframework.orm.jpa.LocalContainerEntityManagerFactoryBean"
      p:dataSource-ref="dataSource"
      p:persistenceUnitName="simple-jpa"/>
</beans>
```
2. JPA Entity Configuration

The @Entity annotation indicates that the JavaBean is a persistent entity. JPA would automatically pick up this class except the JPA configuration explicitly registers the classes each persistence unit should handle. An @Table annotation can explicitly configure which table the entity is mapped to, although in this case it isn't necessary since it would default to the name of the class which matches the table name.

The one-to-many relationship from Person to Address is configured on public Set<Address> getAddresses(). The @OneToMany(fetch=FetchType.EAGER) annotation indicates a one-to-many relationship and that any associated addresses should be eagerly fetched. The @JoinColumn(name="PERSON_ID", nullable=false) annotation indicates ADDRESS.PERSON_ID is the column to match against PERSON.ID to retrieve addresses associated with a person.

**Note**

Using the ImprovedNamingStrategy in your JPA persistence.xml can give better translation from camel case classes and field names to standard underscore delimited database names. An example of this is that instead of having to explicitly put @Column(name="FIRST_NAME") on the first name field, it automatically converts the camel case of the field name to use underscores.
/**
 * Sets id (primary key).
 */
public void setId(Integer id) {
    this.id = id;
}

/**
 * Gets first name.
 */
public String getFirstName() {
    return firstName;
}

/**
 * Sets first name.
 */
public void setFirstName(String firstName) {
    this.firstName = firstName;
}

/**
 * Gets last name.
 */
public String getLastName() {
    return lastName;
}

/**
 * Sets last name.
 */
public void setLastName(String lastName) {
    this.lastName = lastName;
}

/**
 * Gets list of <code>Address</code>es.
 */
@OneToMany(fetch = FetchType.EAGER, cascade = CascadeType.ALL)
@JoinColumn(name = "PERSON_ID", nullable = false)
public Set<Address> getAddresses() {
    return addresses;
}

/**
 * Sets list of <code>Address</code>es.
 */
public void setAddresses(Set<Address> addresses) {
    this.addresses = addresses;
}

/**
 * Gets date created.
 */
public Date getCreated() {
    return created;
}

/**
 * Sets date created.
 */
public void setCreated(Date created) {
    this.created = created;
}

...
### Example 1 Excerpt from Person

```java
@javax.persistence.Entity
public class Address implements Serializable {
    private static final long serialVersionUID = 7851794269407495684L;

    private Integer id = null;
    private String address = null;
    private String city = null;
    private String state = null;
    private String zipPostal = null;
    private String country = null;
    private Date created = null;

    /**
     * Gets id (primary key).
     */
    @javax.persistence.Id
    @javax.persistence.GeneratedValue(strategy = GenerationType.AUTO)
    public Integer getId() {
        return id;
    }

    /**
     * Sets id (primary key).
     */
    public void setId(Integer id) {
        this.id = id;
    }

    /**
     * Gets address.
     */
    public String getAddress() {
        return address;
    }

    /**
     * Sets address.
     */
    public void setAddress(String address) {
        this.address = address;
    }

    /**
     * Gets city.
     */
    public String getCity() {
        return city;
    }

    /**
     * Sets city.
     */
    public void setCity(String city) {
        this.city = city;
    }

    /**
     * Gets state.
     */
    public String getState() {
        return state;
    }

    /**
     * Sets state.
     */
    public void setState(String state) {
        this.state = state;
    }
}
```

One to Many JPA Hibernate Configuration
public void setState(String state) {
    this.state = state;
}
/**
 * Gets zip or postal code.
 */
public String getZipPostal() {
    return zipPostal;
}
/**
 * Sets zip or postal code.
 */
public void setZipPostal(String zipPostal) {
    this.zipPostal = zipPostal;
}
/**
 * Gets country.
 */
public String getCountry() {
    return country;
}
/**
 * Sets country.
 */
public void setCountry(String country) {
    this.country = country;
}
/**
 * Gets date created.
 */
public Date getCreated() {
    return created;
}
/**
 * Sets date created.
 */
public void setCreated(Date created) {
    this.created = created;
}
...
scanning would normally be fine.

The `properties` element can have a list of properties to pass into JPA provider for configuring provider specific details. In this case the database being used, whether or not to show generated SQL, whether or not to to generate the schema or validate an existing one, the naming strategy, and the cache provider.

**Note**

In production it would be better to use Ehcache [http://ehcache.org/](http://ehcache.org/) for the cache provider.

```xml
<property name="hibernate.cache.provider_class" value="org.hibernate.cache.EhCacheProvider" />
```

Excerpt from `META-INF/persistence.xml`

```xml
<?xml version="1.0" encoding="UTF-8"?>
<persistence xmlns="http://java.sun.com/xml/ns/persistence"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://java.sun.com/xml/ns/persistence http://java.sun.com/xml/ns/persistence/persistence_2_0.xsd"
    version="2.0">
    ...
    <persistence-unit name="simple-jpa">
        <provider>org.hibernate.ejb.HibernatePersistence</provider>
        <class>org.springbyexample.orm.jpa.bean.Person</class>
        <class>org.springbyexample.orm.jpa.bean.Address</class>
        <exclude-unlisted-classes/>
        <properties>
            <property name="hibernate.dialect" value="org.hibernate.dialect.HSQLDialect" />
            <property name="hibernate.show_sql" value="true" />
            <property name="hibernate.ejb.naming_strategy" value="org.hibernate.cfg.ImprovedNamingStrategy"/>
            <property name="hibernate.cache.provider_class" value="org.hibernate.cache.HashtableCacheProvider" />
        </properties>
    </persistence-unit>
    ...
</persistence>
```

### 4. Code Example

```java
@Repository
```
@Transactional(readOnly = true)
public class PersonDaoImpl implements PersonDao {
    private EntityManager em = null;
    /**
     * Sets the entity manager.
     */
    @PersistenceContext
    public void setEntityManager(EntityManager em) {
        this.em = em;
    }
    /**
     * Find persons.
     */
    public Person findPersonById(Integer id) {
        return em.find(Person.class, id);
    }
    /**
     * Find persons using a start index and max number of results.
     */
    @SuppressWarnings("unchecked")
    public Collection<Person> findPersons(final int startIndex, final int maxResults) {
        return em.createQuery("select p from Person p order by p.lastName, p.firstName"
                .setFirstResult(startIndex).setMaxResults(maxResults).getResultList());
    }
    /**
     * Find persons.
     */
    @SuppressWarnings("unchecked")
    public Collection<Person> findPersons() {
        return em.createQuery("select p from Person p order by p.lastName,
                p.firstName"").getResultList();
    }
    /**
     * Find persons by last name.
     */
    @SuppressWarnings("unchecked")
    public Collection<Person> findPersonsByLastName(String lastName) {
        return em.createQuery("select p from Person p where p.lastName = :lastName order by
                p.lastName, p.firstName")
                .setParameter("lastName", lastName).getResultList();
    }
    /**
     * Saves person.
     */
    @Transactional(readOnly = false, propagation = Propagation.REQUIRES_NEW)
    public Person save(Person person) {
        return em.merge(person);
    }
    /**
     * Deletes person.
     */
    @Transactional(readOnly = false, propagation = Propagation.REQUIRES_NEW)
    public void delete(Person person) {
        em.remove(em.merge(person));
    }
    /**
     * Saves address to person.
     */
    @Transactional(readOnly = false, propagation = Propagation.REQUIRES_NEW)
    public Person saveAddress(Integer id, Address address) {
        Person person = findPersonById(id);
        // Code to save address
```java
if (person.getAddresses().contains(address)) {
    person.getAddresses().remove(address);
}

person.getAddresses().add(address);
return save(person);
}

/**
 * Deletes address from person.
 */
@Transactional(readOnly = false, propagation = Propagation.REQUIRES_NEW)
public Person deleteAddress(Integer id, Integer addressId) {
    Person person = findPersonById(id);

    Address address = new Address();
    address.setId(addressId);

    if (person.getAddresses().contains(address)) {
        for (Address a : person.getAddresses()) {
            if (a.getId().equals(addressId)) {
                em.remove(a);
                person.getAddresses().remove(address);
                break;
            }
        }
    }

    return person;
}
```
General Setup Instructions

General instructions for checking out the project with Eclipse and building with Maven.

Example Project Setup

Project Information

- Spring Framework 3.2.x
- Java Persistence API 2.0
JPA Joined Inheritance

David Winterfeldt

2009

This shows a JPA configuration for inheritance. There are three different types, which are single table, joined, and table per class. This example uses joined inheritance. Joined inheritance involves a base table for shared fields and a table for each subclass. There is a Person class that is the parent for Student and Professional. This example is based on One to Many JPA Hibernate Configuration, but has been modified enough to add inheritance.

1. Spring Configuration

The Person DAO is configured using context:component-scan. Then tx:annotation-driven will configure transactions on any beans with @Transactional, and just after it the JPA transaction manager is setup. The jdbc:embedded-database element is used to initialize the test HSQLDB database. The LocalContainerEntityManagerFactoryBean is configured with the DataSource and for use with Hibernate as the JPA adapter. The persistenceUnitName attribute is set to specify which persistence unit to use (multiple examples use the persistence.xml).

PersonInheritanceDaoTest-context.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:p="http://www.springframework.org/schema/p"
    xmlns:context="http://www.springframework.org/schema/context"
    xmlns:jdbc="http://www.springframework.org/schema/jdbc"
    xmlns:tx="http://www.springframework.org/schema/tx"
    xsi:schemaLocation="http://www.springframework.org/schema/beans
        http://www.springframework.org/schema/beans/spring-beans.xsd
        http://www.springframework.org/schema/context
        http://www.springframework.org/schema/context/spring-context.xsd
        http://www.springframework.org/schema/jdbc
        http://www.springframework.org/schema/jdbc/spring-jdbc.xsd
        http://www.springframework.org/schema/tx
        http://www.springframework.org/schema/tx/spring-tx.xsd">

    <context:component-scan base-package="org.springbyexample.orm.jpa.inheritance.dao" />

    <tx:annotation-driven />

    <bean id="transactionManager"
        class="org.springframework.orm.jpa.JpaTransactionManager"
        p:entityManagerFactory-ref="entityManagerFactory"/>

    <jdbc:embedded-database id="dataSource" type="HSQL">
        <jdbc:script location="classpath:/schema_inheritance.sql" encoding="UTF-8" />
    </jdbc:embedded-database>

    <bean id="entityManagerFactory"
        class="org.springframework.orm.jpa.LocalContainerEntityManagerFactoryBean"
        p:dataSource-ref="dataSource"
        p:persistenceUnitName="inheritance-jpa">
        <property name="jpaVendorAdapter">
            <bean class="org.springframework.orm.jpa.vendor.HibernateJpaVendorAdapter" />
        </property>
        <bean class="org.springframework.orm.jpa.vendor.hibernate.HibernateJpaVendorAdapter" />
    </bean>

</beans>
```
2. JPA Entity Configuration

The `javax.persistence` annotation `@Entity` indicates this is a persistent entity bean, and JPA would pick it up during classpath scanning. Although in this configuration, JPA scanning for entity beans is turned off. An `@Table` annotation can explicitly configure which table the entity is mapped to, although in this case it isn't necessary since it would default to the name of the class which matches the table name.

**Note**

Using the `ImprovedNamingStrategy` in your JPA `persistence.xml` can give better translation from camel case classes and field names to standard underscore delimited database names. An example of this is that instead of having to explicitly put `@Column(name="FIRST_NAME")` on the first name field, it automatically converts the camel case of the field name to use underscores.

```xml
<property name="hibernate.ejb.naming_strategy" value="org.hibernate.cfg.ImprovedNamingStrategy"/>
```

Inheritance is configured using the `@Inheritance` and `@DiscriminatorColumn` annotations. The `@Inheritance` configures the inheritance type to joined. The `@DiscriminatorColumn` annotation sets the field used to determine the subclass to the `TYPE` field and the field type to integer.

```java
@Entity
@Inheritance(strategy = InheritanceType.JOINED)
@DiscriminatorColumn(name="TYPE", discriminatorType=DiscriminatorType.INTEGER)
public class Person implements Serializable {
    private static final long serialVersionUID = -2175150694352541150L;
    private Integer id = null;
    private String firstName = null;
    private String lastName = null;
    private Set<Address> addresses = null;
    private Date created = null;

    /**
     * Gets id (primary key).
     */
    @Id
    @GeneratedValue(strategy=GenerationType.AUTO)
    public Integer getId() {
        return id;
    }

    /**
     * Sets id (primary key).
     */
    public void setId(Integer id) {
```
this.id = id;
}

/**
 * Gets first name.
 */
public String getFirstName() {
    return firstName;
}

/**
 * Sets first name.
 */
public void setFirstName(String firstName) {
    this.firstName = firstName;
}

/**
 * Gets last name.
 */
public String getLastName() {
    return lastName;
}

/**
 * Sets last name.
 */
public void setLastName(String lastName) {
    this.lastName = lastName;
}

/**
 * Gets list of <code>Address</code>es.
 */
@OneToMany(fetch=FetchType.EAGER, cascade=CascadeType.ALL)
@JoinColumn(name="PERSON_ID", nullable=false)
public Set<Address> getAddresses() {
    return addresses;
}

/**
 * Sets list of <code>Address</code>es.
 */
public void setAddresses(Set<Address> addresses) {
    this.addresses = addresses;
}

/**
 * Gets date created.
 */
public Date getCreated() {
    return created;
}

/**
 * Sets date created.
 */
public void setCreated(Date created) {
    this.created = created;
}

public Address findAddressById(Integer id) {
    Address result = null;

    if (addresses != null) {
        for (Address address : addresses) {
            if (address.getId().equals(id)) {
                result = address;
                break;
            }
        }
    }

    return result;
}
Example 1 Excerpt from Person

The Student class extends Person. The @DiscriminatorValue indicates the value to be used for the discriminator column in the parent class when storing and retrieving this subclass. The PERSON_STUDENT table stores all the extra values unique to this subclass, which in this case is just the school name of the student.

```java
@Entity
@Table(name="PERSON_STUDENT")
@DiscriminatorValue("1")
public class Student extends Person {
    private static final long serialVersionUID = -8933409594928827120L;
    private String schoolName = null;
    /**
     * Gets school name.
     */
    public String getSchoolName() {
        return schoolName;
    }

    /**
     * Sets school name.
     */
    public void setSchoolName(String schoolName) {
        this.schoolName = schoolName;
    }
}
```

Example 2 Student

The Professional class is very similar to the Student class except it has a different table, discriminator value, and its unique field is the professional's company name.

```java
@Entity
@Table(name="PERSON_PROFESSIONAL")
@DiscriminatorValue("2")
public class Professional extends Person {
    private static final long serialVersionUID = 8199967229715812072L;
    private String companyName = null;
    /**
     * Gets company name.
     */
    public String getCompanyName() {
        return companyName;
    }

    /**
     * Sets company name.
     */
    public void setCompanyName(String companyName) {
        this.companyName = companyName;
    }
}
```
Example 3 Professional

3. JPA Configuration

Hibernate is setup as the JPA provider. Another JPA provider, like EclipseLink [http://www.eclipse.org/eclipselink/], could be specified and if all your code just uses JPA nothing else would need to be changed. The Person & Address classes are explicitly configured, and JPA's scanning for entity beans is turned off by specifying the exclude-unlisted-classes element. Some Hibernate specific configuration items are set within the properties element.

Excerpt from META-INF/persistence.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<persistence xmlns="http://java.sun.com/xml/ns/persistence"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://java.sun.com/xml/ns/persistence
    http://java.sun.com/xml/ns/persistence/persistence_2_0.xsd"
    version="2.0">
    ...
    <persistence-unit name="inheritance-jpa">
        <provider>org.hibernate.ejb.HibernatePersistence</provider>
        <class>org.springframework.orm.jpa.inheritance.bean.Student</class>
        <class>org.springframework.orm.jpa.inheritance.bean.Professional</class>
        <class>org.springframework.orm.jpa.inheritance.bean.Address</class>
        <exclude-unlisted-classes/>
        <properties>
            <property name="hibernate.dialect" value="org.hibernate.dialect.HSQLDialect" />
            <property name="hibernate.show_sql" value="true" />
            <property name="hibernate.hbm2ddl.auto" value="validate" />
            <property name="hibernate.ejb.naming_strategy" value="org.hibernate.cfg.ImprovedNamingStrategy" />
            <property name="hibernate.cache.provider_class" value="org.hibernate.cache.HashtableCacheProvider" />
        </properties>
    </persistence-unit>
</persistence>
```
4. Code Example

```java
@Repository
@Transactional(readOnly = true)
public class PersonInheritanceImpl implements PersonInheritanceDao {  
  private EntityManager em = null;
  /**
   * Sets the entity manager.
   */
  @PersistenceContext
  public void setEntityManager(EntityManager em) {
    this.em = em;
  }
  /**
   * Find persons.
   */
  public Person findPersonById(Integer id) {
    return em.find(Person.class, id);
  }
  /**
   * Find persons using a start index and max number of results.
   */
  @SuppressWarnings("unchecked")
  public Collection<Person> findPersons(final int startIndex, final int maxResults) {
    return em.createQuery("select p from Person p order by p.lastName, p.firstName"
      .setFirstResult(startIndex).setMaxResults(maxResults).getResultList();
  }
  /**
   * Find persons.
   */
  @SuppressWarnings("unchecked")
  public Collection<Person> findPersons() {
    return em.createQuery("select p from Person p order by p.lastName, p.firstName"
      .setParameter("lastName", lastName).getResultList();
  }
  /**
   * Find persons by last name.
   */
  @SuppressWarnings("unchecked")
  public Collection<Person> findPersonsByLastName(String lastName) {
    return em.createQuery("select p from Person p where p.lastName = :lastName order by p.lastName, p.firstName"
      .setParameter("lastName", lastName).getResultList();
  }
  /**
   * Saves person.
   */
  @Transactional(readOnly = false, propagation = Propagation.REQUIRES_NEW)
  public Person save(Person person) {
    return em.merge(person);
  }
  /**
   * Deletes person.
   */
  @Transactional(readOnly = false, propagation = Propagation.REQUIRES_NEW)
  public void delete(Person person) {
    em.remove(em.merge(person));
  }
```
* Saves address to person.
*/
@Transactional(readOnly = false, propagation = Propagation.REQUIRES_NEW)
public Person saveAddress(Integer id, Address address) {
    Person person = findPersonById(id);
    if (person.getAddresses().contains(address)) {
        person.getAddresses().remove(address);
    }
    person.getAddresses().add(address);
    return save(person);
}

/**
* Deletes address from person.
*/
@Transactional(readOnly = false, propagation = Propagation.REQUIRES_NEW)
public Person deleteAddress(Integer id, Integer addressId) {
    Person person = findPersonById(id);
    Address address = new Address();
    address.setId(addressId);
    if (person.getAddresses().contains(address)) {
        for (Address a : person.getAddresses()) {
            if (a.getId().equals(addressId)) {
                em.remove(a);
                person.getAddresses().remove(address);
                break;
            }
        }
    }
    return person;
}

Example 4 PersonInheritanceImpl

5. SQL Script

Excerpt from schema_inheritance.sql

... CREATE TABLE PERSON_TYPE (ID integer identity primary key, NAME varchar(50) not null, CREATED timestamp, CONSTRAINT IDX_PERSON_TYPE_ID PRIMARY KEY (ID) );

CREATE TABLE PERSON (ID integer identity primary key, FIRST_NAME varchar(50) not null, LAST_NAME varchar(50) not null, TYPE integer,
CREATE TABLE PERSON.Student {  
  ID integer not null,  
  SCHOOL_NAME varchar(50) not null,  
  CREATED timestamp,  
  CONSTRAINT FK_PERSON_STUDENT_ID FOREIGN KEY (ID) REFERENCES PERSON(ID) on delete cascade  
};  

CREATE TABLE PERSON.Professional {  
  ID integer not null,  
  COMPANY_NAME varchar(50) not null,  
  CREATED timestamp,  
  CONSTRAINT FK_PERSON_PROFESSIONAL_ID FOREIGN KEY (ID) REFERENCES PERSON(ID) on delete cascade  
};  

CREATE TABLE Address {  
  ID integer identity primary key,  
  PERSON_ID integer,  
  ADDRESS varchar(255),  
  CITY varchar(50) not null,  
  STATE varchar(50) null,  
  ZIP_POSTAL varchar(30) not null,  
  COUNTRY varchar(50) not null,  
  CREATED timestamp,  
  CONSTRAINT IDX_ADDRESS_ID PRIMARY KEY (ID),  
  CONSTRAINT FK_ADDRESS_PERSON_ID FOREIGN KEY (PERSON_ID) REFERENCES PERSON(ID) on delete cascade  
};
General Setup Instructions

General instructions for checking out the project with Eclipse and building with Maven.

Example Project Setup

Project Information

- Spring Framework 3.2.x
- Java Persistence API 2.0
This shows basic usage of Spring Data JPA [http://www.springsource.org/spring-data/jpa] for some simple queries, and create/update/delete. It has a lot of customization points, including items like query auto-generation by convention, query hints, and auditing. This example builds on the JPA Joined Inheritance example and has the same data structure.

1. Spring Configuration

Instead of using context:component-scan, Spring Data JPA [http://www.springsource.org/spring-data/jpa]'s jpa namespace is used. The jpa:repositories scans for all interfaces that extend JpaRepository and creates implementations for use at runtime.

Excerpt from PersonRepositoryTest-context.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<jpa:repositories base-package="org.springbyexample.orm.repository"/>

<bean id="transactionManager" class="org.springframework.orm.jpa.JpaTransactionManager" p:entityManagerFactory-ref="entityManagerFactory"/>

<jdbc:embedded-database id="dataSource" type="HSQL">
  <jdbc:script location="classpath:/schema.sql" encoding="UTF-8"/>
</jdbc:embedded-database>

<bean id="entityManagerFactory" class="org.springframework.orm.jpa.LocalContainerEntityManagerFactoryBean" p:dataSource-ref="dataSource" p:persistenceUnitName="hsql">
  <property name="jpaVendorAdapter">
    <bean class="org.springframework.orm.jpa.vendor.HibernateJpaVendorAdapter"/>
  </property>
</bean>

...
2. JPA Configuration

The persistence-unit is named 'hsql'. When supporting tests and a production database, controlling which persistence unit is loaded can be done with Spring Profiles.

META-INF/persistence.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<persistence xmlns="http://java.sun.com/xml/ns/persistence"
        xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
        xsi:schemaLocation="http://java.sun.com/xml/ns/persistence
        http://java.sun.com/xml/ns/persistence/persistence_2_0.xsd"
        version="2.0">
  <persistence-unit name="hsql">
    <provider>org.hibernate.ejb.HibernatePersistence</provider>
    <properties>
      <property name="hibernate.dialect" value="org.hibernate.dialect.HSQLDialect" />
      <property name="hibernate.show_sql" value="true" />
      <property name="hibernate.hbm2ddl.auto" value="validate" />
      <property name="hibernate.ejb.naming_strategy" value="org.hibernate.cfg.ImprovedNamingStrategy" />
      <property name="hibernate.cache.provider_class" value="org.hibernate.cache.HashtableCacheProvider" />
      <property name="jadira.usertype.autoRegisterUserTypes" value="true" />
      <property name="jadira.usertype.databaseZone" value="jvm" />
    </properties>
  </persistence-unit>
</persistence>
```


3. Repository

The repository extends JpaRepository and passes the JPA entity and it's primary key being managed. Basic methods for finding a single record, all records, paginated records, create/update, and delete are automatically provided. It's also very easy to overload any custom query to add pagination and sorting.

The findByFirstNameLike method let's Spring Data JPA [http://www.springsource.org/spring-data/jpa] automatically generate a like query for the first name column, and findByLastName for an equals query for the last name column. The third method, findByAddress, creates a custom query using @Query and a standard JQL query. @Param is used before the method param to create a named parameter. Otherwise it would have created a position based param (ex: 'a.address = ?0').

Note

Refer to Spring Data JPA [http://www.springsource.org/spring-data/jpa]'s query creation section to see all the different ways the method name can be overloaded to automatically generate queries (And/Or/Between/LessThan/GreaterThan/etc.).
public interface PersonRepository extends JpaRepository<Person, Integer> {  
    
    public final static String FIND_BY_ADDRESS_QUERY = "SELECT p " +  
            "FROM Person p LEFT JOIN p.addresses a " +  
            "WHERE a.address = :address";

    /**
     * Find persons like first name.
     */
    public List<Person> findByFirstNameLike(String firstName);

    /**
     * Find persons by last name.
     */
    public List<Person> findByLastName(String lastName);

    /**
     * Find persons by address.
     */
    @Query(FIND_BY_ADDRESS_QUERY)
    public List<Person> findByAddress(@Param("address") String address);

    ...
}

Example 1 PersonRepository

The second findByAddress query performs the same search as the first one, but a Pageable parameter has been added to the method. The page, and number of records for a page can be passed in.

Note

Besides being able to add Pageable, there is also a Sort parameter that can be added. A PageRequest, which implements Pageable, can also take sort information. So only a Pageable or Sort needs to be added to a repository method.

public interface PersonRepository extends JpaRepository<Person, Integer> {  
    ...

    /**
     * Find paged persons by address.
     */
    @Query(FIND_BY_ADDRESS_QUERY)
    public Page<Person> findByAddress(@Param("address") String address, Pageable page);

    ...
}

Example 2 PersonRepository Page Query
The final query, `findByName`, searches for first and last name using a custom query. But instead of embedding the query in Java it is named query in the `orm.xml`. This may make it easier to manage larger queries.

**Note**

The query is automatically matched to `${domainClassName}.${methodName}`, but this can be overridden using the `@Query` name attribute.

```xml
<?xml version="1.0" encoding="UTF-8"?>
<entity-mappings xmlns="http://java.sun.com/xml/ns/persistence/orm"
                 xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
                 xsi:schemaLocation="http://java.sun.com/xml/ns/persistence/orm orm_2_0.xsd"
                 version="2.0">
  <named-query name="Person.findByName">
    <query>select p from Person p where p.firstName = :firstName AND p.lastName = :lastName</query>
  </named-query>
</entity-mappings>
```

```java
public interface PersonRepository extends JpaRepository<Person, Integer> {
  ...
  /**
   * Find persons by first and last name.
   */
  public List<Person> findByName(@Param("firstName") String firstName, @Param("lastName") String lastName);
}
```

**Example 3 PersonRepository Named Query**

## 4. Code Example

```java
Person person = personRepository.findOne(FIRST_ID);
```

**Example 4 Excerpt from PersonRepositoryTest Find by PK**

```java
Collection<Person> persons = personRepository.findAll();
```
Example 5 Excerpt from PersonRepositoryTest Find All

```java
List<Person> persons = personRepository.findByFirstNameLike("J%");
```

Example 6 Excerpt from PersonRepositoryTest Find by First Name Like

```java
List<Person> persons = personRepository.findByName(LAST_NAME);
```

Example 7 Excerpt from PersonRepositoryTest Find by Last Name

```java
List<Person> persons = personRepository.findByAddress(ADDR);
```

Example 8 Excerpt from PersonRepositoryTest Find by Address

```java
Page<Person> pageResult = personRepository.findByAddress(ADDR, new PageRequest(page, size));
List<Person> persons = pageResult.getContent();
```

Example 9 Excerpt from PersonRepositoryTest Paginated Find by Address

```java
List<Person> persons = personRepository.findByName(FIRST_NAME, LAST_NAME);
```

Example 10 Excerpt from PersonRepositoryTest Find by First & Last Name

Note

In Spring Data JPA [http://www.springsource.org/spring-data/jpa], save and update are both handled by `save` or `saveAndFlush`.

```java
Professional person = new Professional();
Set<Address> addresses = new HashSet<Address>();
Address address = new Address();
drop.add(address);
```
address.setAddress(addr);
address.setCity(CITY);
address.setState(STATE);
address.setZipPostal(ZIP_POSTAL);
address.setCountry(COUNTRY);

person.setFirstName(firstName);
person.setLastName(lastName);
person.setCompanyName(companyName);
person.setCreated(new Date());
person.setAddresses(addresses);

Person result = personRepository.saveAndFlush(person);

Example 11 Excerpt from PersonRepositoryTest Save

Person person = personRepository.findOne(FIRST_ID);
testPersonOne(person);

String lastName = "Jones";
person.setLastName(lastName);
personRepository.saveAndFlush(person);

Example 12 Excerpt from PersonRepositoryTest Update

personRepository.delete(FIRST_ID);

Example 13 Excerpt from PersonRepositoryTest Delete

5. Reference

Related Links

• Spring Data JPA [http://www.springsource.org/spring-data/jpa]

• Spring Data JPA 1.1.x Documentation [http://static.springsource.org/spring-data/data-jpa/docs/1.1.x/reference/html/]

Project Setup

Follow the Project Checkout instructions for git, then go to the project (relative path below).

$ cd persistence/spring-data-jpa
General Setup Instructions

General instructions for checking out the project with Eclipse and building with Maven.

Example Project Setup

Project Information

- Spring Framework 3.2.x
- Spring Data JPA 1.4.x
- Java Persistence API 2.0
This example shows how to use Spring Data JPA [http://www.springsource.org/spring-data/jpa] auditing. It sets up AOP based auditing for a create and last updated user & date.

1. Spring Configuration

The *jpa:auditing* element activates auditing and needs an instance of *AuditorAware*.

Excerpt from *PersonRepositoryTest-context.xml*

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:p="http://www.springframework.org/schema/p"
    xmlns:jdbc="http://www.springframework.org/schema/jdbc"
    xmlns:jpa="http://www.springframework.org/schema/data/jpa"
    xsi:schemaLocation="http://www.springframework.org/schema/beans
    http://www.springframework.org/schema/beans/spring-beans.xsd
    http://www.springframework.org/schema/jdbc
    http://www.springframework.org/schema/jdbc/spring-jdbc.xsd
    http://www.springframework.org/schema/data/jpa
    http://www.springframework.org/schema/data/jpa/spring-jpa.xsd">
    <!-- auditing -->
    <jpa:auditing auditor-aware-ref="auditorAware" />
    <bean id="auditorAware" class="org.springbyexample.orm.entity.AuditorAwareImpl" />
</beans>
```

2. JPA Configuration


Excerpt from *META-INF/persistence.xml*

```xml
<?xml version="1.0" encoding="UTF-8"?>
<persistence xmlns="http://java.sun.com/xml/ns/persistence"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://java.sun.com/xml/ns/persistence
    http://java.sun.com/xml/ns/persistence/persistence_2_0.xsd"/>
```
3. Code Example

This is a very simple example that just returns a static value.

Note

If Spring Security [http://www.springsource.org/spring-security/] was setup, the method could return the current user.

```java
return SecurityContextHolder.getContext().getAuthentication().getName();
```

```java
public class AuditorAwareImpl implements AuditorAware<String> {
    @Override
    public String getCurrentAuditor() {
        return "SYSTEM";
    }
}
```

**Example 1 AuditorAwareImpl**

This auditing class extends Spring Data JPA [http://www.springsource.org/spring-data/jpa]'s AbstractPersistable, which has an auto-increment primary key field in it and some utility methods. The Auditable interface uses generics to take the user and it's primary key type.

Note

If the reference of AuditorAware was setup to be a user entity, then Spring Data JPA
http://www.springsource.org/spring-data/jpa]’s AbstractAuditable could be used as the entity base.

Notice the @MappedSuperclass annotation. It indicates it is designated to have it’s field mappings used by subclasses.

```java
@MappedSuperclass
@SuppressWarnings("serial")
public class AbstractAuditableEntity extends AbstractPersistable<Integer> implements Auditable<String, Integer> {
    private DateTime lastUpdated;
    private String lastUpdateUser;
    private DateTime created;
    private String createUser;

    /**
     * Gets created by audit user.
     */
    @Override
    public String getCreatedBy() {
        return createUser;
    }

    /**
     * Sets created by audit user.
     */
    @Override
    public void setCreatedBy(String createdBy) {
        this.createUser = createdBy;
    }

    /**
     * Gets create audit date.
     */
    @Override
    public DateTime getCreatedDate() {
        return created;
    }

    /**
     * Sets create audit date.
     */
    @Override
    public void setCreatedDate(DateTime creationDate) {
        this.created = creationDate;
    }

    /**
     * Gets last modified by audit user.
     */
    @Override
    public String getLastModifiedBy() {
        return lastUpdateUser;
    }

    /**
     * Sets last modified by audit user.
     */
    @Override
    public void setLastModifiedBy(String lastModifiedBy) {
        this.lastUpdateUser = lastModifiedBy;
    }

    /**
     * Gets last modified audit date.
     */
```
Example 2 AbstractAuditableEntity

The Person class extends AbstractAuditableEntity. By doing that it gets a primary key and audit fields, along with getters/setters for the inherited fields, equals, and hashCode. Only the fields that are specific to this type need to be defined.

```
@Entity
@Inheritance(strategy = InheritanceType.JOINED)
@DiscriminatorColumn(name="TYPE", discriminatorType=DiscriminatorType.INTEGER)
public class Person extends AbstractAuditableEntity {
    private static final long serialVersionUID = -2175150694352541150L;
    private String firstName = null;
    private String lastName = null;
    @OneToMany(fetch=FetchType.EAGER, cascade=CascadeType.ALL)
    @JoinColumn(name="PERSON_ID", nullable=false)
    private Set<Address> addresses = null;
    ...
}
```

Example 3 Excerpt from Person

4. SQL Script

Excerpt from schema.sql

```
CREATE TABLE PERSON (
    ID INTEGER generated by default as identity (start with 1) not null,
    FIRST_NAME varchar(50) not null,
    LAST_NAME varchar(50) not null,
    TYPE integer, 
    LAST_UPDATED TIMESTAMP DEFAULT CURRENT_TIMESTAMP NOT NULL,
    ...
)
```
5. Reference

Related Links

- Spring Data JPA Example
- Spring Data JPA [http://www.springsource.org/spring-data/jpa]
- Spring Data JPA 1.1.x Documentation [http://static.springsource.org/spring-data/data-jpa/docs/1.1.x/reference/html/]

Project Setup

Follow the Project Checkout instructions for git, then go to the project (relative path below).

```bash
$ cd persistence/spring-data-jpa
```

General Setup Instructions

General instructions for checking out the project with Eclipse and building with Maven.
Example Project Setup

**Project Information**

- Spring Framework 3.2.x
- Spring Data JPA 1.4.x
- Java Persistence API 2.0
Hibernate Transaction Annotation Configuration

David Winterfeldt
2008

Creating basic transaction using annotations with Spring for Hibernate.

1. Spring Configuration

To process annotation-based transaction configuration a transactionManager bean needs to be created and this will be used by <tx:annotation-driven/> for managing transactions.

PersonDaoTransactionTest-context.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xmlns:p="http://www.springframework.org/schema/p"
      xmlns:tx="http://www.springframework.org/schema/tx"
      xsi:schemaLocation="http://www.springframework.org/schema/beans
                        http://www.springframework.org/schema/beans/spring-beans.xsd
                        http://www.springframework.org/schema/tx
                        http://www.springframework.org/schema/tx/spring-tx.xsd">

  <import resource="classpath:org/springbyexample/orm/hibernate3/shared-context.xml"/>

  <bean id="transactionManager"
        class="org.springframework.orm.hibernate3.HibernateTransactionManager"
        p:sessionFactory-ref="sessionFactory" />

  <tx:annotation-driven/>

  <bean id="personDao"
        class="org.springbyexample.orm.hibernate3.dao.PersonDaoImpl"
        p:sessionFactory-ref="sessionFactory" />

</beans>
```

2. Code Example

The Hibernate SessionFactory is used to create a HibernateTemplate as it's set. The template is then used for any Hibernate database operations. Spring's HibernateTemplate converts all exceptions to runtime exceptions so it isn't necessary to handle any exceptions.

The @Transactional annotation configures the class and all it's methods for read only access, but the save method overrides this by specifying it's own annotation of @Transactional(readOnly = false, propagation = Propagation.REQUIRES_NEW).
@Repository
@Repository
@Transactional(readOnly = true)
public class PersonDaoImpl implements PersonDao {
    protected HibernateTemplate template = null;
    /**
     * Sets Hibernate session factory.
     */
    public void setSessionFactory(SessionFactory sessionFactory) {
        template = new HibernateTemplate(sessionFactory);
    }
    /**
     * Find persons.
     */
    @SuppressWarnings("unchecked")
    public Collection<Person> findPersons() throws DataAccessException {
        return template.find("from Person");
    }
    /**
     * Find persons by last name.
     */
    @SuppressWarnings("unchecked")
    public Collection<Person> findPersonsByLastName(String lastName) throws DataAccessException {
        return template.find("from Person p where p.lastName = ?", lastName);
    }
    /**
     * Saves person.
     */
    @Transactional(readOnly = false, propagation = Propagation.REQUIRES_NEW)
    public void save(Person person) {
        template.saveOrUpdate(person);
    }
}

Example 1 PersonDaoImpl

3. Reference

Related Links

- Spring 3.2.x Hibernate Documentation [http://static.springsource.org/spring/docs/3.2.x/spring-framework-reference/html/orm.html#orm-hibernate]
- Spring 3.2.x JDBC Custom Namespace [http://static.springsource.org/spring/docs/3.2.x/spring-framework-reference/html/jdbc.html#jdbc-embedded-database-support]
- Hibernate [http://www.hibernate.org/]
- Apache Commons DBCP [http://commons.apache.org/dbcp]
- One to Many Hibernate XML Configuration
• One to Many Hibernate Annotation Configuration

Project Setup

Follow the Project Checkout instructions for git, then go to the project (relative path below).

$ cd persistence/simple-hibernate

General Setup Instructions

General instructions for checking out the project with Eclipse and building with Maven.

Example Project Setup

Project Information

• Spring Framework 3.2.x

• Hibernate 3.6.10.Final
Simple Spring Transactional JUnit 4 Test

David Winterfeldt
2008

Simple Spring Transactional JUnit 4 Test of a Hibernate transaction.

1. Spring Configuration

A `transactionManager` bean is setup for the transactional annotations to use and the `DataSource` from the shared context (not shown) is used by `AbstractTransactionalJUnit4SpringContextTests` to make a `SimpleJdbcTemplate` available.

`PersonDaoTransactionUnitTest-context.xml`

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xmlns:p="http://www.springframework.org/schema/p"
      xmlns:tx="http://www.springframework.org/schema/tx"
      xsi:schemaLocation="http://www.springframework.org/schema/beans
                           http://www.springframework.org/schema/beans/spring-beans.xsd
                           http://www.springframework.org/schema/tx
                           http://www.springframework.org/schema/tx/spring-tx.xsd">
  <import resource="classpath:org/springbyexample/orm/hibernate3/shared-context.xml"/>
  <bean id="transactionManager"
        class="org.springframework.orm.hibernate3.HibernateTransactionManager"
        p:sessionFactory-ref="sessionFactory" />
  <tx:annotation-driven />
  <bean id="personDao"
        class="org.springbyexample.orm.hibernate3.dao.PersonDaoImpl"
        p:sessionFactory-ref="sessionFactory" />
</beans>
```

2. Code Example

The `@RunWith` annotation is part of JUnit 4 and is set to use `SpringJUnit4ClassRunner` to run the unit test. The other annotations, except for `@Test`, are Spring annotations. `@ContextConfiguration` initializes the Spring context and by default looks for a Spring XML file in the same package as the unit test with the file name the same as the class with '-context.xml' as a suffix (ex: `PersonDaoTransactionUnitTest-context.xml`). `@TransactionConfiguration` and `@Transactional` configure transactions for the tests.
The method with @Test is the main test method which saves a person in a transaction. The method with @BeforeTransaction is run before the transaction starts and the method with @AfterTransaction is run after the transaction ends. They both use SimpleJdbcTemplate to directly check the database and avoid any caching Hibernate might be performing.

```java
@RunWith(SpringJUnit4ClassRunner.class)
@ContextConfiguration
@TransactionConfiguration
@Transactional
public class PersonDaoTransactionUnitTest extends AbstractTransactionalJUnit4SpringContextTests {

    final Logger logger = LoggerFactory.getLogger(PersonDaoTransactionUnitTest.class);

    protected static int SIZE = 2;
    protected static Integer ID = new Integer(1);
    protected static String FIRST_NAME = "Joe";
    protected static String LAST_NAME = "Smith";
    protected static String CHANGED_LAST_NAME = "Jackson";

    @Autowired
    protected PersonDao personDao = null;

    /**
     * Tests that the size and first record match what is expected
     * before the transaction.
     */
    @BeforeTransaction
    public void beforeTransaction() {
        testPerson(true, LAST_NAME);
    }

    /**
     * Tests person table and changes the first records last name.
     */
    @Test
    public void testHibernateTemplate() throws SQLException {
        assertNotNull("Person DAO is null.", personDao);
        Collection<Person> lPersons = personDao.findPersons();
        assertNotNull("Person list is null.", lPersons);
        assertEquals("Number of persons should be " + SIZE + ".", SIZE, lPersons.size());
        for (Person person : lPersons) {
            assertNotNull("Person is null.", person);
            if (ID.equals(person.getId())) {
                assertEquals("Person first name should be " + FIRST_NAME + ".", FIRST_NAME, person.getFirstName());
                assertEquals("Person last name should be " + LAST_NAME + ".", LAST_NAME, person.getLastName());
                person.setLastName(CHANGED_LAST_NAME);
                personDao.save(person);
            }
        }
    }

    /**
     * Tests that the size and first record match what is expected
     * after the transaction.
     */
    @AfterTransaction
    public void afterTransaction() {
        testPerson(false, LAST_NAME);
    }
}
```
/**
 * Tests person table.
 */

protected void testPerson(boolean beforeTransaction, String matchLastName) {
    List<Map<String, Object>> lPersonMaps = simpleJdbcTemplate.queryForList("SELECT * FROM PERSON");

    assertNotNull("Person list is null.", lPersonMaps);
    assertEquals("Number of persons should be " + SIZE + ".", SIZE, lPersonMaps.size());

    Map<String, Object> hPerson = lPersonMaps.get(0);

    logger.debug((beforeTransaction ? "Before" : "After") + " transaction. " + hPerson.toString());

    Integer id = (Integer)hPerson.get("ID");
    String firstName = (String)hPerson.get("FIRST_NAME");
    String lastName = (String)hPerson.get("LAST_NAME");

    if (ID.equals(id)) {
        assertEquals("Person first name should be " + FIRST_NAME + ".", FIRST_NAME, firstName);
        assertEquals("Person last name should be " + matchLastName + ".", matchLastName, lastName);
    }
}

Example 1 PersonDaoTransactionUnitTest

3. Reference

Related Links

- JUnit [http://www.junit.org/]
- Spring 3.2.x Hibernate Documentation [http://static.springsource.org/spring/docs/3.2.x/spring-framework-reference/html/orm.html#orm-hibernate]
- Spring 3.2.x JDBC Custom Namespace [http://static.springsource.org/spring/docs/3.2.x/spring-framework-reference/html/jdbc.html#jdbc-embedded-database-support]
- Hibernate [http://www.hibernate.org/]
- Apache Commons DBCP [http://commons.apache.org/dbcp]

Project Setup

Follow the Project Checkout instructions for git, then go to the project (relative path below).

$ cd persistence/simple-orm
General Setup Instructions

General instructions for checking out the project with Eclipse and building with Maven.

Example Project Setup

Project Information

- Spring Framework 3.2.x
- Hibernate 3.6.10.Final
Part IV. Web

Web application examples.
Simple Tiles 2 Spring MVC Webapp

David Winterfeldt

2008

This is a simple example showing how to setup Spring MVC to use Tiles 2. Any request coming in mapped for Tiles processing will attempt to find a Tiles definition that matches the request and then render it.

1. Spring Configuration

The tilesConfigurer bean initializes tiles with all the tiles configuration files (more than one can be specified). The tilesViewResolver bean defines using Spring’s TilesView which uses the url to lookup the Tiles definition and render it.

```
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:p="http://www.springframework.org/schema/p"
    xmlns:mvc="http://www.springframework.org/schema/mvc"
    xsi:schemaLocation="http://www.springframework.org/schema/beans
                        http://www.springframework.org/schema/beans/spring-beans.xsd
                        http://www.springframework.org/schema/mvc
                        http://www.springframework.org/schema/mvc/spring-mvc.xsd">

    <mvcc:view-controller path="/index.html" />
    <mvcc:view-controller path="/info/about.html" />

    <bean id="tilesConfigurer"
        class="org.springframework.web.servlet.view.tiles2.TilesConfigurer"
        p:definitions="/WEB-INF/tiles-defs/templates.xml" />

    <bean id="tilesViewResolver"
        class="org.springframework.web.servlet.view.UrlBasedViewResolver"
        p:viewClass="org.springframework.web.servlet.view.tiles2.TilesView" />

</beans>
```

2. Tiles XML Configuration

The Tiles 'mainTemplate' sets up the default layout and the other two definitions extend the main template and just set their body.

```
<?xml version="1.0" encoding="ISO-8859-1" ?>
<!DOCTYPE tile-definitions PUBLIC
    "-//Apache Software Foundation//DTD Tiles Configuration 2.0//EN"

```
3. JSP Example

This JSP has the main layout for where the header, footer, menu, and body are located. They are inserted using Tiles custom JSP tags.

/web-INF/templates/menu.jsp

```html
<%@ taglib prefix="c" uri="http://java.sun.com/jsp/jstl/core" %>
<%@ taglib uri="http://tiles.apache.org/tags-tiles" prefix="tiles"%>

<html>
<head>
<title><tiles:getAsString name="title" /></title>
<link rel="stylesheet" type="text/css" href="<c:url value="/css/main.css"/>" />
</head>
<body>
<div id="header">
  <div id="headerTitle"><tiles:insertAttribute name="header" /></div>
</div>
<div id="menu">
  <tiles:insertAttribute name="menu" />
</div>
<div id="content">
  <tiles:insertAttribute name="body" />
</div>
<div id="footer">
  <tiles:insertAttribute name="footer" />
</div>
</body>
</html>
```
4. Reference

Related Links

- Spring 3.2.x Tiles Documentation
  [http://static.springsource.org/spring/docs/3.2.x/spring-framework-reference/html/view.html#view-tiles]

- Tiles 2 [http://tiles.apache.org/]

Project Setup

Follow the Project Checkout instructions for git, then go to the project (relative path below).

```
$ cd web/simple-tiles2-webapp
```

General Setup Instructions

General instructions for checking out the project with Eclipse and building with Maven.

Example Project Setup

Project Information

- Spring Framework 3.2.x
Basic Webapp Internationalization

David Winterfeldt

2008

Creating a basic webapp that will handle UTF-8 characters from form input and also have internationalized messages.

1. Web Configuration

The character encoding type for the request can be set using the CharacterEncodingFilter [http://static.springsource.org/spring/docs/3.2.x/javadoc-api/org/springframework/web/filter/CharacterEncodingFilter.html]. By setting this, when a form values are retrieved from the request the encoding type will be UTF-8.

```
<filter>
    <filter-name>encoding-filter</filter-name>
    <filter-class>org.springframework.web.filter.CharacterEncodingFilter</filter-class>
    <init-param>
        <param-name>encoding</param-name>
        <param-value>UTF-8</param-value>
    </init-param>
</filter>

<filter-mapping>
    <filter-name>encoding-filter</filter-name>
    <url-pattern>/*</url-pattern>
</filter-mapping>
```

2. Spring Configuration

This configures the web application for internationalized messages that can then be displayed in a JSP page using the JSTL message format tag. The `basenames` property of ResourceBundleMessageSource is set to 'messages' which will then look for the default message resource of messages.properties. Based on different locales, other property files can be defined like messages_es.properties for Spanish.

The LocaleChangeInterceptor is configured to look for the parameter name 'locale' to indicate a change of the user's locale, and is registered as an interceptor using the Spring MVC Namespace. The Spring MVC Namespace is new in Spring 3.0. For example, adding 'locale=es' to a URL would change the locale to Spanish. The SessionLocaleResolver keeps the user's currently configured locale in session scope.

```
Excerpt from /WEB-INF/spring/webmvc-context.xml
```
<bean id="messageSource" class="org.springframework.context.support.ResourceBundleMessageSource" p:basenames="messages" />

<!-- Declare the Interceptor -->
<mvc:interceptors>
  <bean class="org.springframework.web.servlet.i18n.LocaleChangeInterceptor" p:paramName="locale" />
</mvc:interceptors>

<!-- Declare the Resolver -->
<bean id="localeResolver" class="org.springframework.web.servlet.i18n.SessionLocaleResolver" />

3. JSP Example

To make sure pages display UTF-8 characters properly, it's important to set the page encoding and content type at the very top of the JSP page. Since this example webapp is using Tiles, it's only necessary to set it at the top of the main template.

Excerpt from /WEB-INF/templates/main.jsp

```jsp
<%@ page pageEncoding="UTF-8" contentType="text/html; charset=UTF-8" %>
```

The footer of the Tiles template shows how to display something from the message resource files and also how to create a link to change locales. The `<fmt:message>` retrieves 'button.locale' from the property file that matches the current locale, or if that key isn't in the current locale's file it will use the default locale's message.

The URL to change the locale uses the `<c:url>` JSTL tag and redirects to the home page. It sets the parameter to match what was configured on the `LocaleChangeInterceptor` bean's `paramName` property. Which in this case is 'locale'. Passing in no locale switches to the default locale and for Spanish the parameter 'es' is used.

/WEB-INF/templates/footer.jsp

```jsp
<%@ taglib prefix="c" uri="http://java.sun.com/jsp/jstl/core" %>
<%@ taglib prefix="fmt" uri="http://java.sun.com/jsp/jstl/fmt" %>

<div align="right">
  <div>
    <fmt:message key="button.locale"/>
    <c:url var="englishLocaleUrl" value="/index.html">
      <c:param name="locale" value="" />
    </c:url>
    <a href='<c:out value="${englishLocaleUrl}"/>'><fmt:message key="locale.english"/></a>
    <c:url var="spanishLocaleUrl" value="/index.html">
      <c:param name="locale" value="es" />
    </c:url>
    <a href='<c:out value="${spanishLocaleUrl}"/>'><fmt:message key="locale.spanish"/></a>
  </div>
</div>
```
4. Message Resource Property Files

Excerpt from messages.properties

button.cancel=Cancel
button.create=Create
button.edit=Edit
button.delete=Delete
button.reset=Reset
button.save=Save
button.search=Search
button.locale=Language
locale.english=English
locale.spanish=Español

site.title=Simple Spring MVC Form Annotation-based Configuration

Excerpt from messages_es.properties

button.cancel=Cancelar
button.create=Crear
button.edit=Corregir
button.delete=Borrar
button.reset=Restaurar
button.save=Guardar
button.search=Buscar
button.locale=Lenguaje

site.title=Simple Configuración Spring MVC usando Anotaciones

5. Reference

Related Links

• Spring 3.2.x Internationalization using MessageSource Documentation [http://static.springsource.org/spring/docs/3.2.x/spring-framework-reference/html/beans.html#context-functionality-messagesource]
Project Setup

Follow the Project Checkout instructions for git, then go to the project (relative path below).

```
$ cd web/simple-form-annotation-config-webapp
```

General Setup Instructions

General instructions for checking out the project with Eclipse and building with Maven.

Example Project Setup

Project Information

- Spring Framework 3.2.x
Simple Spring MVC Form Annotation Configuration Webapp

David Winterfeldt
2008

Simple Spring MVC form using annotation-based configuration. The webapp has basic create, update, delete, and search functionality for a person form. The form basically just has a hidden id (primary key), first name, and last name fields. Tiles is implemented with Spring by Example's Dynamic Tiles Spring MVC Module, Hibernate, and internationalized messages are configured, but this example will focus on explaining the MVC configuration.

1. Web Configuration

Below is the basic web.xml configuration. All Spring contexts in /WEB-INF/spring and end in *-context.xml will be loaded into one context. The default context file specific to the simple-form servlet is overridden to not load anything (/WEB-INF/simple-form-servlet.xml would have been loaded otherwise, the name of the DispatcherServlet plus '-servlet.xml'). The servlet-mapping for 'simple-form' is configured to handle all requests ending in '.html'. The 'encoding-filter' sets all requests to the encoding type of UTF-8.

/web-INF/web.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<web-app xmlns="http://java.sun.com/xml/ns/javae"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://java.sun.com/xml/ns/javae
    http://java.sun.com/xml/ns/javae/web-app_3_0.xsd"
    version="3.0" metadata-complete="true">
    <display-name>simple-form</display-name>
    <listener>
        <listener-class>
            org.springframework.web.context.ContextLoaderListener
        </listener-class>
    </listener>
    <context-param>
        <param-name>contextConfigLocation</param-name>
        <param-value>
            /WEB-INF/spring/*-context.xml
        </param-value>
    </context-param>
    <filter>
        <filter-name>encoding-filter</filter-name>
        <filter-class>
            org.springframework.web.filter.CharacterEncodingFilter
        </filter-class>
        <init-param>
            <param-name>encoding</param-name>
            <param-value>UTF-8</param-value>
        </init-param>
    </filter>
</web-app>
```
2. Spring Configuration

This standard Spring MVC configuration file creates handlers, configures Tiles, and also internationalization. The context:component-scan registers the PersonController, which is defined in the org.springbyexample.web.servlet.mvc package. The mvc:annotation-driven element registers a DefaultAnnotationHandlerMapping and AnnotationMethodHandlerAdapter. It also sets up type converters and a Bean Validation (JSR-303) validator (if JSR-303 library is present on the classpath). The mvc:view-controller element sets an explicit mapping to the static index page.

The tilesConfigurer bean configures tiles and dynamicTilesViewResolver takes the url of a request and uses it for the body in a Tiles template. The last three beans configure locale and message resource handling. The LocaleChangeInterceptor is registered as an interceptor with the default handler by the surrounding mvc:interceptors element.

/WEB-INF/spring/webmvc-context.xml
3. JSP Example

The `form:form` custom JSP tag is configured to post to the URL '/person/form.html', which based on the ControllerClassNameHandlerMapping would map to the `form` method on the PersonController configured to receive a post request. The form is bound to the 'person' model, which is the default for the PersonController. The `form:hidden` custom JSP tag binds to the Person's id and `form:input` is used to bind 'firstName' and 'lastName'.

`WEB-INF/jsp/person/form.jsp`
The search displays all records in the person table and generates links to edit and delete a record. The \texttt{fmt:message} tag retrieves the local sensitive message based on the message resource key passed in.

/WEB-INF/jsp/person/search.jsp

4. Code Example

The \texttt{@Controller} indicates the class is a Spring MVC controller stereotype which is automatically registered by \texttt{context:component-scan} in the \texttt{web-application-context.xml}. The \texttt{@RequestMapping} annotation on the methods use the \texttt{value} attribute to map the method to a path. The \texttt{method} attribute is used to indicate the HTTP request type (ex: GET, POST, DELETE). More sophisticated targeting based on available parameters can also be done, but is not needed in this example.
The first method, `newRequest`, is annotated with `@ModelAttribute`. This indicates that the method will be called before every request. In this case it takes the request parameter 'id', but doesn't require the parameter. By default specifying `@RequestParameter` would cause an error if it wasn't available and no other method was available for processing the request. The `newRequest` method looks up the person from the database and returns it or if the 'id' param is null it returns a new instance for the form to bind to. Without specifying a specific name for the model to be bound to, it will be bound to the class name. So Person will be bound to 'person'.

The first form method handles a create and edit for an HTTP GET request since it's annotated with `@RequestMapping(method=RequestMethod.GET)`. It's just a place holder since the `newRequest` method has already created or retrieved the appropriate bean from the db. By default, Spring will continue forwarding the request where it was headed before it was intercepted by the controller. This could be changed by returning a `String` with the new path or by returning a view instance (like `ModelAndView`).

The second form method handles a save from the person form. It will only accept a request that is an HTTP POST and it has the method signature `form(Person person, Model model)`. By specifying the `person` variable, Spring will automatically retrieve or create (depending on it's scope) an instance of `Person` and bind any available request parameters to it. Since it is also the default model object, any values set on it will be available on the page the request forwards to. The `Model` is made available just by specifying it. This can also be done for the `HttpServletRequest` and `HttpServletResponse`. The method sets a create date if one isn't already set, saves the person bean, then returns the saved person instance which replaces the existing model after a success message is set on the model for display on form.

The last two method are delete and search. The delete method is very straight forward. It just deletes person, and then redirects to the search page. The search method retrieves all persons and returns them in a `Collection`. It doesn't explicitly set the return value to be bound to the scope 'persons' using the `@ModelAttribute(SEARCH_MODEL_KEY)'.

```java
@Controller
public class PersonController {
    private static final String SEARCH_VIEW_KEY = "redirect:search.html";
    private static final String SEARCH_MODEL_KEY = "persons";

    private final PersonRepository repository;

    @Autowired
    public PersonController(PersonRepository repository) {
        this.repository = repository;
    }

    /**
     * For every request for this controller, this will create a person instance for the form.
     */
    @ModelAttribute
    public Person newRequest(@RequestParam(required=false) Integer id) {
        return (id != null ? repository.findOne(id) : new Person());
    }

    /**
     * <p>Person form request.</p>
     * 
     * <p>Expected HTTP GET and request '/person/form'.</p>
     */
    @RequestMapping(value="/person/form", method=RequestMethod.GET)
    public void form() {};
```

Spring by Example Version 1.3
Example 1 PersonController

5. Reference

Related Links

- Spring 3.2.x Defining a controller with @Controller Documentation [http://static.springsource.org/spring/docs/3.2.x/spring-framework-reference/html/mvc.html#mvc-ann-controller]


- Spring by Example's Dynamic Tiles 2 Spring MVC Module

Project Setup
Follow the Project Checkout instructions for git, then go to the project (relative path below).

```
$ cd web/simple-form-annotation-config-webapp
```

**General Setup Instructions**

General instructions for checking out the project with Eclipse and building with Maven.

Example Project Setup

**Project Information**

- Spring Framework 3.2.x
Simple Spring Security Webapp

David Winterfeldt

2008

Simple Spring Security 3.1 example securing a webapp based on the Simple Spring MVC Form Annotation Configuration Webapp. All URLs are restricted to valid users except the login, logoff, and style sheet. Only admins have the ability to delete a record. A non-admin doesn't see the link on the search page to delete a record and also calling the delete method on the service is restricted to admins.

1. Web Configuration

The 'springSecurityFilterChain' filter needs to be configured to intercept all URLs so Spring Security can control access to them. The filter must be named this to match the default bean it retrieves from the Spring context.

/WEB-INF/web.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<web-app xmlns="http://java.sun.com/xml/ns/javaee"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://java.sun.com/xml/ns/javaee
http://java.sun.com/xml/ns/javaee/web-app_3_0.xsd"
    version="3.0" metadata-complete="true">

    <display-name>simple-security</display-name>

    <listener>
        <listener-class>
            org.springframework.web.context.ContextLoaderListener
        </listener-class>
    </listener>

    <context-param>
        <param-name>contextConfigLocation</param-name>
        <param-value>WEB-INF/spring/*-context.xml</param-value>
    </context-param>

    <!-- Enables Spring Security -->
    <filter>
        <filter-name>springSecurityFilterChain</filter-name>
        <filter-class>
            org.springframework.web.filter.DelegatingFilterProxy
        </filter-class>
    </filter>

    <filter>
        <filter-name>encoding-filter</filter-name>
        <filter-class>
            org.springframework.web.filter.CharacterEncodingFilter
        </filter-class>
        <init-param>
            <param-name>encoding</param-name>
            <param-value>UTF-8</param-value>
        </init-param>
    </filter>

</web-app>
```
2. Spring Configuration

The `security:global-method-security` element configures annotation based security so `@Secured` can be used to restrict access to methods.

The `security:http` is set to auto-configure basic HTTP security. Inside the the login, logout, and main style sheet are set to the anonymous role (unrestricted access). The rest of the site is restricted to an authenticated user in the user role. The default login and logout configuration is also customized to use custom pages to maintain the sites look & feel.

The authentication is set to use jdbc based user authentication. Only the `DataSource` needs to be set on the `security:jdbc-user-service` element if the default tables are used. Although other tables can be used by setting custom queries on the element.

`/WEB-INF/spring/security-context.xml`

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:security="http://www.springframework.org/schema/security"
  xsi:schemaLocation="http://www.springframework.org/schema/beans
  http://www.springframework.org/schema/beans/spring-beans.xsd
  http://www.springframework.org/schema/security
  http://www.springframework.org/schema/security/spring-security-3.1.xsd">
  <security:global-method-security secured-annotations="enabled" />
  <security:http auto-config="true">
  </security:http>
</beans>
```
3. JSP Example

The security tag is defined at the top of the page with a prefix of 'sec'. Then around delete link the `sec:authorize` tag is configured to only show the link if the user is in the role 'ROLE_ADMIN'. Now, this doesn't actually stop someone from executing a delete query if they know the URL. Below, in the PersonService, the `@Secured` tag is configured to enforce the rule that only an admin can delete a record.

/Web-INF/jsp/person/search.jsp

```jsp
<%@ taglib prefix="c" uri="http://java.sun.com/jsp/jstl/core"%>
<%@ taglib prefix="fmt" uri="http://java.sun.com/jsp/jstl/fmt"%>
<%@ taglib prefix="form" uri="http://www.springframework.org/tags/form"%>
<%@ taglib prefix="sec" uri="http://www.springframework.org/security/tags"%>

<h1><fmt:message key="person.search.title"/></h1>
<table class="search">
<tr>
    <th><fmt:message key="person.form.firstName"/></th>
    <th><fmt:message key="person.form.lastName"/></th>
</tr>
<c:forEach var="person" items="${persons}" varStatus="status">
    <tr>
        <c:set var="personFormId" value="person${status.index}"/>
        <c:url var="editUrl" value="/person/form.html">
            <c:param name="id" value="${person.id}"/>
        </c:url>
        <sec:authorize ifAllGranted="ROLE_ADMIN">
            <c:url var="deleteUrl" value="/person/delete.html"/>
            <form id="${personFormId}" action="${deleteUrl}" method="POST">
                <input id="id" name="id" type="hidden" value="${person.id}"/>
            </form>
        </sec:authorize>
        <td>${person.firstName}</td>
        <td>${person.lastName}</td>
    </tr>
</c:forEach>
</table>
```
4. Code Example

The delete method has access restricted to users in the admin role by putting the @Secured annotation above it and setting the allowed roles. Which in this case is only the 'ROLE_ADMIN' role. By securing the service interface, even if a non-admin user tries to execute the delete URL they will not be able to delete a record.

```java
public interface PersonService {

  /**
   * Find person by id.
   */
  public Person findById(Integer id);

  /**
   * Find persons.
   */
  public Collection<Person> find();

  /**
   * Saves person.
   */
  public Person save(Person person);

  /**
   * Deletes person.
   */
  @Secured ("ROLE_ADMIN")
  public void delete(Person person);
}
```

**Example 1 PersonService**

You may wonder why the 'delete/person*' URL wasn't restricted. For the current application, this would have been sufficient. But we don't really want to restrict the URL, we want to restrict the actual delete action. Spring Security makes it very easy to restrict access to actual methods. If at some point in the future the another URL is made to also delete a record, our rule will still be enforced. Also, if at some point someone creates a method that calls delete that is accessed by a completely different URL, only admins will be able to execute this new part of the application successfully. A new implementation of the interface will also have the same rule applied to since the security annotation was placed on the interface and not the implementation itself.
5. SQL Script

security_schema.sql

```
SET IGNORECASE TRUE;

CREATE TABLE users ( 
    username VARCHAR(50) NOT NULL PRIMARY KEY, 
    password VARCHAR(50) NOT NULL,
    enabled BIT NOT NULL 
);

CREATE TABLE authorities ( 
    username VARCHAR(50) NOT NULL,
    authority VARCHAR(50) NOT NULL
);
CREATE UNIQUE INDEX ix_auth_username ON authorities (username, authority);
ALTER TABLE authorities ADD CONSTRAINT fk_authorities_users foreign key (username) REFERENCES users(username);

INSERT INTO users VALUES ('david', 'newyork', true);
INSERT INTO users VALUES ('alex', 'newjersey', true);
INSERT INTO users VALUES ('tim', 'illinois', true);

INSERT INTO authorities VALUES ('david', 'ROLE_USER');
INSERT INTO authorities VALUES ('david', 'ROLE_ADMIN');
INSERT INTO authorities VALUES ('alex', 'ROLE_USER');
INSERT INTO authorities VALUES ('tim', 'ROLE_USER');
```

6. Reference

Related Links

- Spring Security Site [http://static.springsource.org/spring-security/site/]
- Simple Spring MVC Form Annotation Configuration Webapp

Project Setup

Follow the Project Checkout instructions for git, then go to the project (relative path below).

```
$ cd web/simple-spring-security-webapp
```

General Setup Instructions
General instructions for checking out the project with Eclipse and building with Maven.

Example Project Setup

**Project Information**

- Spring Framework 3.2.x
- Spring Security 3.1.x
Simple Spring Web Flow Webapp

David Winterfeldt

2008

A very simple Spring Web Flow 2.3 example using a flow to create and edit a Person. A Spring MVC annotation-based controller still handles search and deleting records. The example is built on Simple Spring MVC Form Annotation Configuration Webapp and Simple Spring Security Webapp which can be referred to for better explanations of Spring MVC Annotations and Spring Security.

1. Web Configuration

This would be optional, but to use any of the Spring JavaScript the ResourceServlet needs to be configured. You can see some basic resources loaded in the excerpt from the master Tiles template.

Excerpt from /WEB-INF/web.xml

```xml
<!-- Serves static resource content from .jar files such as spring-faces.jar -->
<servlet>
    <servlet-name>resources</servlet-name>
    <servlet-class>org.springframework.js.resource.ResourceServlet</servlet-class>
    <load-on-startup>0</load-on-startup>
</servlet>

<servlet>
    <servlet-name>simple-form</servlet-name>
    <servlet-class>org.springframework.web.servlet.DispatcherServlet</servlet-class>
    <init-param>
        <param-name>contextConfigLocation</param-name>
        <param-value></param-value>
    </init-param>
    <load-on-startup>1</load-on-startup>
</servlet>

<!-- Map all /resources requests to the Resource Servlet for handling -->
<servlet-mapping>
    <servlet-name>resources</servlet-name>
    <url-pattern>/resources/*</url-pattern>
</servlet-mapping>

<servlet-mapping>
    <servlet-name>simple-form</servlet-name>
    <url-pattern>*.html</url-pattern>
</servlet-mapping>
```

2. Spring Configuration

Basic Spring Web Flow configuration with Tiles as the view resolver and the security flow execution listener. The webflow:flow-registry element registers the person flow. The person flow XML file is stored with the person form and search page. A flow specific message resources file (messages.properties) could also be put in this location.
The handlers are configured so flows and annotation-based controllers can be used together. The url '/person.html' is mapped to the person flow in the flowMappings bean and assigned a custom flow handler, which redirects to the search page at the end of the flow and if an exception not handled by the flow occurs.

The mvc:annotation-driven configures annotation-based handlers for the controllers. The mvc:view-controller element sets explicit mappings to the index page, login page, and logout page. None of which needs to go through a controller for rendering.

The tilesViewResolver in the Spring Web Flow example is the AjaxUrlBasedViewResolver, which is able to handle rendering fragments of a Tiles context. It's viewClass property set to use FlowAjaxDynamicTilesView.
This example uses AJAX to populate just the body of the page on a form submit. Also, Spring by Example’s Dynamic Tiles Spring MVC Module is used to reduce the Tiles configuration.

/WEB-INF/spring/webmvc-context.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
   xmlns:p="http://www.springframework.org/schema/p"
   xmlns:context="http://www.springframework.org/schema/context"
   xmlns:mvc="http://www.springframework.org/schema/mvc"
   xsi:schemaLocation="http://www.springframework.org/schema/beans
   http://www.springframework.org/schema/beans/spring-beans.xsd
   http://www.springframework.org/schema/context
   http://www.springframework.org/schema/context/spring-context.xsd
   http://www.springframework.org/schema/mvc
   http://www.springframework.org/schema/mvc/spring-mvc.xsd">
  <context:component-scan base-package="org.springbyexample.web.servlet.mvc" />
  <!-- URL to flow mapping rules -->
  <bean id="flowMappings" class="org.springframework.web.servlet.handler.SimpleUrlHandlerMapping"
       p:order="0">
    <property name="mappings">
      <value>/person.html=personFlowHandler</value>
    </property>
  </bean>
  <mvc:annotation-driven />
  <mvc:view-controller path="/index.html" />
  <mvc:view-controller path="/login.html" />
  <mvc:view-controller path="/logoutSuccess.html" />
  <bean id="tilesConfigurer" class="org.springframework.web.servlet.view.tiles2.TilesConfigurer"
       p:definitions="/WEB-INF/tiles-defs/templates.xml" />
  <bean id="tilesViewResolver" class="org.springframework.web.servlet.view.UrlBasedViewResolver"
       p:viewClass="org.springbyexample.web.servlet.view.tiles2.DynamicTilesView"
       p:prefix="/WEB-INF/jsp/" p:suffix=".jsp" />
  <bean id="messageSource" class="org.springframework.context.support.ResourceBundleMessageSource"
       p:basenames="messages" />
  <!-- Declare the Interceptor -->
  <mvc:interceptors>
    <bean class="org.springframework.web.servlet.i18n.LocaleChangeInterceptor"
         p:paramName="locale" />
  </mvc:interceptors>
  <!-- Declare the Resolver -->
  <bean id="localeResolver" class="org.springframework.web.servlet.i18n.SessionLocaleResolver" />
</beans>
```

Custom flow for person handling create and edit. The decision-state checks if the id is null and if it is it goes to the 'create' action-state, otherwise it goes to the 'editPerson' action-state. In 'create' the personBean bean, which is scoped as a prototype bean (new instance for each call), is called and the value is put into 'flowScope' under 'person.
The evaluation is performed using the Spring Expression Language (Spring EL), which has been used by Spring Web Flow [http://www.springsource.org/spring-web-flow] since version 2.1. The 'edit' action-state uses the Spring Data JPA [http://www.springsource.org/spring-data/jpa] person repository to look the person record based on the id in the edit URL.

Both create and edit forward to the 'personForm' view where the user has a save and cancel button. Both of these buttons are handled using the transition element. The 'save' transition saves the person using the person repository. Then both save and cancel populate the latest search results and forward to end-state elements that have their view set to the person search page.

The flow is secured to the Spring Security role of 'ROLE_USER'. Which in this case is redundant since the entire webapp is secured to this role, but finer grained rules can make use of this and also it's good to secure the flow since they are reusable components (as subflows).

**Person Flow (/WEB-INF/jsp/person/person.xml)**

```xml
<?xml version="1.0" encoding="UTF-8"?>
<flow xmlns="http://www.springframework.org/schema/webflow"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xsi:schemaLocation="http://www.springframework.org/schema/webflow
       http://www.springframework.org/schema/webflow/spring-webflow-2.0.xsd">
  <secured attributes="ROLE_USER" />
  <input name="id" />
  <decision-state id="createOrEdit">
    <if test="id == null" then="create" else="edit" />
  </decision-state>
  <action-state id="create">
    <evaluate expression="personBean" result="flowScope.person" />
    <transition to="personForm" />
  </action-state>
  <action-state id="edit">
    <evaluate expression="personService.findById(id)"
               result="flowScope.person" />
    <transition to="personForm" />
  </action-state>
  <view-state id="personForm" model="person" view="/person/form">
    <transition on="save" to="save">
      <evaluate expression="personService.save(person)"
                  result="flowScope.persons" />
    </transition>
    <transition on="cancel" to="cancel" bind="false">
      <evaluate expression="personService.find()"
                  result="flowScope.persons" />
    </transition>
  </view-state>
  <end-state id="save"/>
  <end-state id="cancel"/>
</flow>
```
3. JSP Example

All '/resources' URLs are resolved by Spring JavaScript's the ResourceServlet configured in the web.xml.

**Excerpt from /WEB-INF/templates/main.jsp**

```html
<link type="text/css" rel="stylesheet" href="<c:url value="/resources/dijit/themes/tundra/tundra.css" />" />
<script type="text/javascript" src="<c:url value="/resources/dojo/dojo.js" />"></script>
<script type="text/javascript" src="<c:url value="/resources/spring/Spring.js" />"></script>
<script type="text/javascript" src="<c:url value="/resources/spring/Spring-Dojo.js" />"></script>
```

The create link goes to '/person.html' which is mapped to the person flow. The search link still goes through the PersonController. Both the create and search links are secured so when the login and logout pages are rendered, these links aren't displayed until the user logs in.

**/WEB-INF/templates/menu.jsp**

```html
<%@ taglib prefix="c" uri="http://java.sun.com/jsp/jstl/core" %>
<%@ taglib prefix="fmt" uri="http://java.sun.com/jsp/jstl/fmt" %>
<%@ taglib prefix="sec" uri="http://www.springframework.org/security/tags" %>

<div id="side-bar">
  <a href="<c:url value="/" />">Home</a>
  <sec:authorize ifAllGranted="ROLE_USER">
    <p><fmt:message key="person.form.title" /></p>
    <a href="<c:url value="/person.html" />"><fmt:message key="button.create" /></a>
    <a href="<c:url value="/person/search.html" />"><fmt:message key="button.search" /></a>
  </sec:authorize>

</div>
```

The edit link goes to the person flow (ex: '/person.html?id=1'). The flow will look up the person record based on the id request parameter.

**/WEB-INF/jsp/person/search.jsp**

```html
<%@ taglib prefix="c" uri="http://java.sun.com/jsp/jstl/core" %>
<%@ taglib prefix="fmt" uri="http://java.sun.com/jsp/jstl/fmt" %>
<%@ taglib prefix="form" uri="http://www.springframework.org/tags/form" %>
<%@ taglib prefix="sec" uri="http://www.springframework.org/security/tags" %>

<h1><fmt:message key="person.search.title" /></h1>
<table class="search">
  <tr>
    <th><fmt:message key="person.form.firstName" /></th>
    <th><fmt:message key="person.form.lastName" /></th>
  </tr>
  <c:forEach var="person" items="${persons}" varStatus="status">
    <tr>
      <td><fmt:message key="person.form.firstName" /></td>
      <td><fmt:message key="person.form.lastName" /></td>
    </tr>
  </c:forEach>
</table>
```
The *form:form* element just needs to have it's *modelAttribute* set to correspond to where the flow put the *Person* instance. The save and cancel buttons specify which event id they are associated with for this step in the flow. This value should match the flow's *transition* element's *on* attribute.

Messages are displayed at the top if there are any status or error messages available. Basic validation is performed by the *PersonValidator*. Which just checks that something has been filled in for the first and last name.

/Web-INF/jsp/person/form.jsp

```xml
<%@ taglib prefix="c" uri="http://java.sun.com/jsp/jstl/core"%>
<%@ taglib prefix="fmt" uri="http://java.sun.com/jsp/jstl/fmt"%>
<%@ taglib prefix="spring" uri="http://www.springframework.org/tags"%>
<%@ taglib prefix="form" uri="http://www.springframework.org/tags/form"%>
<%@ taglib prefix="sec" uri="http://www.springframework.org/security/tags"%>

<h1><fmt:message key="person.form.title"/></h1>

<div id="messages">
    <c:if test="${not empty statusMessageKey}">
        <p><fmt:message key="${statusMessageKey}"/></p>
    </c:if>
</div>

<form:form modelAttribute="person">
    <h2>Errors</h2>
    <div class="formerror">
        <ul>
            <c:forEach var="error" items="${errors.allErrors}">
                <li>${error.defaultMessage}</li>
            </c:forEach>
        </ul>
    </div>
</form:form>
```
4. Code Example

The person controller still handles delete and search.

```java
@Controller
public class PersonController {
    final Logger logger = LoggerFactory.getLogger(getClass());
    static final String SEARCH_VIEW_PATH_KEY = "/person/search";
    private static final String DELETE_PATH_KEY = "/person/delete";
    private static final String SEARCH_VIEW_KEY = "redirect:search.html";
    private static final String SEARCH_MODEL_KEY = "persons";
    private final PersonService service;

    @Autowired
    public PersonController(PersonService service) {
        this.service = service;
    }

    /**
     * Deletes a person.
     * Expected HTTP POST and request '/person/delete'.
     */
    @RequestMapping(value=DELETE_PATH_KEY, method=RequestMethod.POST)
    public String delete(@RequestParam("id") Integer id) {
        logger.info("'{}' id={}", DELETE_PATH_KEY, id);
        service.delete(id);
        return SEARCH_VIEW_KEY;
    }

    /**
     * Searches for all persons and returns them in a
     */
    public String search() {
        return SEARCH_MODEL_KEY;
    }
}
```
Example 1 PersonController

At the end of the flow and when exception occurs that the flow doesn't handle, the PersonFlowHandler redirects to the search page.

Example 2 PersonFlowHandler

Person Validator that is automatically called by Spring Web Flow based on bean name (${model} + 'Validator') and the method based binding in a view-state.
/**
 * Spring Web Flow activated validation (validate + ${state}).
 * Validates 'personForm' view state after binding to person.
 */

public void validatePersonForm(Person person, MessageContext context) {
    if (!StringUtils.hasText(person.getFirstName())) {
        context.addMessage(new MessageBuilder().error().source("firstName").code("person.form.firstName.error").build());
    }
    if (!StringUtils.hasText(person.getLastName())) {
        context.addMessage(new MessageBuilder().error().source("lastName").code("person.form.lastName.error").build());
    }
}

Example 3 PersonValidator

5. Reference

Related Links

- Spring Web Flow Site [http://www.springsource.org/spring-web-flow]
- Simple Spring MVC Form Annotation Configuration Webapp
- Simple Spring Security Webapp

Project Setup

Follow the Project Checkout instructions for git, then go to the project (relative path below).

$ cd web/simple-spring-webflow-webapp

General Setup Instructions

General instructions for checking out the project with Eclipse and building with Maven.

Example Project Setup

Project Information

- Spring Framework 3.2.x
- Spring Security 3.1.x
- Spring Web Flow 2.3.x
Spring Web Flow Subflow Webapp

David Winterfeldt
2008

A Spring Web Flow 2.0 example using a flow to create and edit a Person and a subflow to create and edit a Person’s Addresses. A Spring MVC annotation-based controller still handles search and deleting Person records. The example is built on Simple Spring Web Flow Webapp which can be referred to if necessary.

1. Spring Configuration

This is a basic Spring Web Flow configuration with Tiles as the view resolver and with a Spring Security flow execution listener configured. The webflow:flow-registry element registers the person flow and address subflow. The person flow XML file is stored with the person form and search page, and the address flow is stored with the address form page. A flow specific message resources file (messages.properties) could also be put in these locations.

/WEB-INF/spring/webflow-context.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:p="http://www.springframework.org/schema/p"
xmlns:webflow="http://www.springframework.org/schema/webflow-config"
xsi:schemaLocation="http://www.springframework.org/schema/beans
http://www.springframework.org/schema/beans/spring-beans.xsd
http://www.springframework.org/schema/webflow-config
http://www.springframework.org/schema/webflow-config/spring-webflow-config-2.3.xsd">
  <!-- Enables FlowHandlers -->
  <bean class="org.springframework.webflow.mvc.servlet.FlowHandlerAdapter"
p:flowExecutor-ref="flowExecutor" />
  <!-- Executes flows: the entry point into the Spring Web Flow system -->
  <webflow:flow-executor id="flowExecutor">
    <webflow:flow-execution-listeners>
      <webflow:listener ref="securityFlowExecutionListener" />
    </webflow:flow-execution-listeners>
  </webflow:flow-executor>
  <!-- The registry of executable flow definitions -->
  <webflow:flow-registry id="flowRegistry" flow-builder-services="flowBuilderServices">
    <webflow:flow-location path="/WEB-INF/jsp/person/person.xml" />
    <webflow:flow-location path="/WEB-INF/jsp/address/address.xml" />
  </webflow:flow-registry>
  <!-- Plugs in a custom creator for Web Flow views -->
  <webflow:flow-builder-services id="flowBuilderServices"
view-factory-creator="mvcViewFactoryCreator" />
  <!-- Configures Web Flow to use Tiles to create views for rendering; Tiles allows for applying consistent layouts to your views -->
  <bean id="mvcViewFactoryCreator"
class="org.springframework.webflow.mvc.builder.MvcViewFactoryCreator"
p:viewResolvers-ref="tilesViewResolver" />
  <!-- Installs a listener to apply Spring Security authorities -->
  <bean id="securityFlowExecutionListener"
class="org.springframework.webflow.security.SecurityFlowExecutionListener" />
</beans>
```
The handlers are configured so flows and annotation-based controllers can be used together. The url '/person.html' is mapped to the person flow in the flowMappings bean and assigned a custom flow handler, which redirects to the search page at the end of the flow and if an exception not handled by the flow occurs.

The tilesViewResolver in the Spring Web Flow example is the AjaxUrlBasedViewResolver, which is able to handle rendering fragments of a Tiles context. It's viewClass property is set to use FlowAjaxDynamicTilesView. This example uses AJAX to populate just the body of the page on a form submit. Also, Spring by Example's Dynamic Tiles Spring MVC Module is used to reduce the Tiles configuration.

WEB-INF/spring/webmvc-context.xml

<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xmlns:p="http://www.springframework.org/schema/p"
      xmlns:context="http://www.springframework.org/schema/context"
      xmlns:mvc="http://www.springframework.org/schema/mvc"
      xsi:schemaLocation="http://www.springframework.org/schema/beans
                        http://www.springframework.org/schema/beans/spring-beans.xsd
                        http://www.springframework.org/schema/context
                        http://www.springframework.org/schema/context/spring-context.xsd
                        http://www.springframework.org/schema/mvc
                        http://www.springframework.org/schema/mvc/spring-mvc.xsd">

  <context:component-scan base-package="org.springbyexample.web.servlet.mvc" />
  <!-- URL to flow mapping rules -->
  <bean id="flowMappings"
        class="org.springbyexample.web.servlet.handler.SimpleUrlHandlerMapping"
        p:order="0">
    <property name="mappings">
      <value>/person.html=personFlowHandler</value>
    </property>
  </bean>

  <mvc:annotation-driven />
  <mvc:view-controller path="/index.html" />
  <mvc:view-controller path="/login.html" />
  <mvc:view-controller path="/logoutSuccess.html" />

  <bean id="tilesConfigurer"
        class="org.springframework.web.servlet.view.tiles2.TilesConfigurer"
        p:definitions="/WEB-INF/tiles-defs/templates.xml" />

  <bean id="tilesViewResolver"
        class="org.springframework.web.servlet.view.UrlBasedViewResolver"
        p:viewClass="org.springbyexample.web.servlet.view.tiles2.DynamicTilesView" />

</beans>
Custom flow for person handling create and edit. The decision-state checks if the id is null and if it is it goes to the 'createPerson' action-state, otherwise it goes to the 'editPerson' action-state. In 'createPerson' the prototype scoped personBean bean is put into 'flowScope' under 'person'. The evaluation is performed using the Spring Expression Language (Spring EL), which has been used by Spring Web Flow [http://www.springsource.org/spring-web-flow] since version 2.1. The 'editPerson' action-state uses the Spring Data JPA [http://www.springsource.org/spring-data/jpa] person repository to look the person record based on the id in the edit URL.

Both create and edit forward to the 'personForm' view where the user has a save and cancel button. Both of these buttons are handled using the transition element. The 'save' transition saves the person using the person repository, and puts the result of the save into 'flowScope.person' along with the person id (in case of a create). The success message key is put into 'flashScope' (scope available until next view render), and then goes back to the person form. The cancel populates the latest search results and forward to end-state elements that have their view set to the person search page.

The 'personForm' view also has transitions for handling adding, editing, and deleting addresses. Adding and editing are passed to the 'address' subflow-state. The delete is handled by an evaluate element calling person repository. Both the address id and the person instance are passed into the address subflow. The person instance is used by an edit to retrieve the address to edit instead of looking it up from that database since it's already in scope. At the end of the address flow the address instance is output from the subflow and saved by the person flow's 'address' subflow-state.

Both flows are secured to the Spring Security role of 'ROLE_USER'. Which in this case is redundant since the entire webapp is secured to this role, but finer grained rules can make use of this and also it's good to secure the flow since they are reusable components (as subflows). The subflow could have only allowed only admins to access the address subflow.

**Person Flow (/WEB-INF/jsp/person/person.xml)**

```xml
<?xml version="1.0" encoding="UTF-8"?>
     xsi:schemaLocation="http://www.springframework.org/schema/webflow
                      http://www.springsource.org/schema/webflow/spring-webflow-2.0.xsd">
    <secured attributes="ROLE_USER" />
</flow>
```
The flow is very similar to the person flow. The decision-state handles a create or an edit based on whether or not an id is passed into the flow. Then the action-state for the create put a new Address instance into scope and the edit...
gets it from the person instance. The save outputs the address instance and let's the parent flow handle saves.

**Address Flow (/WEB-INF/jsp/address/address.xml)**

```
<?xml version="1.0" encoding="UTF-8"?>
<flow xmlns="http://www.springframework.org/schema/webflow"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.springframework.org/schema/webflow
http://www.springframework.org/schema/webflow/spring-webflow-2.0.xsd">
  <secured attributes="ROLE_USER" />
  <input name="id" />
  <input name="person" />
  <decision-state id="createOrEdit">
    <if test="id == ''" then="createAddress" else="editAddress" />
  </decision-state>
  <action-state id="createAddress">
    <evaluate expression="addressBean" result="flowScope.address" />
    <transition to="addressForm" />
  </action-state>
  <action-state id="editAddress">
    <evaluate expression="person.findAddressById(id)" result="flowScope.address" />
    <transition to="addressForm" />
  </action-state>
  <view-state id="addressForm" model="address" view="/address/form">
    <transition on="save" to="saveAddress" />
    <transition on="cancel" to="cancelAddress" bind="false" />
  </view-state>
  <end-state id="saveAddress">
    <output name="address" value="address"/>
  </end-state>
  <end-state id="cancelAddress" />
</flow>
```

### 2. JSP Example

The create link goes to `/person.html` which is mapped to the person flow. The search link still goes through the `PersonController`.

**/WEB-INF/templates/menu.jsp**

```
<%@ taglib prefix="c" uri="http://java.sun.com/jsp/jstl/core" %>
<%@ taglib prefix="fmt" uri="http://java.sun.com/jsp/jstl/fmt" %>

<div id="side-bar">
  <a href="">Home</a>
  <p><fmt:message key="person.form.title" /></p>
  <a href="/person.html"><fmt:message key="button.create" /></a>
  <a href="/person/search.html"><fmt:message key="button.search" /></a>
</div>
```
The edit link goes to the person flow (ex: '/person.html?id=1'). The flow will look up the person record based on the id request parameter.

`/WEB-INF/jsp/person/search.jsp`

```html
<%@ taglib prefix="c" uri="http://java.sun.com/jsp/jstl/core" %>
<%@ taglib prefix="fmt" uri="http://java.sun.com/jsp/jstl/fmt" %>
<%@ taglib prefix="form" uri="http://www.springframework.org/tags/form" %>
<%@ taglib prefix="sec" uri="http://www.springframework.org/security/tags" %>

<h1><fmt:message key="person.search.title"/></h1>
<table class="search">
  <tr>
    <th><fmt:message key="person.form.firstName" /></th>
    <th><fmt:message key="person.form.lastName" /></th>
  </tr>
  <c:forEach var="person" items="${persons}">
    <tr>
      <c:url var="editUrl" value="/person.html">
        <c:param name="id" value="${person.id}" />
      </c:url>
      <a href='<c:out value="${editUrl}" />'><fmt:message key="button.edit" /></a>
      <sec:authorize ifAllGranted="ROLE_ADMIN">
        <a href='<c:out value="${deleteUrl}" />'><fmt:message key="button.delete" /></a>
      </sec:authorize>
      <td>${person.firstName}</td>
      <td>${person.lastName}</td>
    </tr>
  </c:forEach>
</table>
```

The `form:form` element just needs to have it's `modelAttribute` set to correspond to where the flow put the Person instance. The save and cancel buttons specify which event id they are associated with for this step in the flow. This value should match the flow's transition element's on attribute.

The link to add an address goes to the address subflow. If there are any addresses, they are displayed in a table with an edit next to each record. There is also a delete link if the user is an admin.

The top of the page has a 'messages' div which can display a status message key or any Spring bind errors. This is where Spring Web Flow will store any errors for automatic validation performed based on a method on the model instance or a bean. In this case, there is a `personValidator` bean that validates if the first and last name are not blank.

`/WEB-INF/jsp/person/form.jsp`
<h1><fmt:message key="person.form.title"/></h1>

<div id="messages">
    <c:if test="${not empty statusMessageKey}">
        <p><fmt:message key="${statusMessageKey}"/></p>
    </c:if>

    <spring:hasBindErrors name="person">
        <h2>Errors</h2>
        <div class="formerror">
            <ul>
                <c:forEach var="error" items="${errors.allErrors}"
                    <li>${error.defaultMessage}</li>
            </ul>
        </div>
    </spring:hasBindErrors>
</div>

<form:form modelAttribute="person">
    <form:hidden path="id" />
    <fieldset>
        <div class="form-row">
            <label for="firstName"><fmt:message key="person.form.firstName"/>:</label>
            <span class="input"><form:input path="firstName" /></span>
        </div>
        <div class="form-row">
            <label for="lastName"><fmt:message key="person.form.lastName"/>:</label>
            <span class="input"><form:input path="lastName" /></span>
        </div>
        <div class="form-buttons">
            <div class="button">
                <input type="submit" id="save" name="_eventId_save" value="<fmt:message key="button.save"/>">
                <input type="submit" name="_eventId_cancel" value="Cancel"/>
            </div>
        </div>
    </fieldset>
</form:form>

<c:if test="${not empty person.id}">
    <div style="clear: both;float:left;">
        <div>
            <a href="${flowExecutionUrl}&_eventId=addAddress" ><fmt:message key="address.form.button.add"/></a>
        </div>
    </c:if>

<c:if test="${empty person.addresses}">
    <p>&nbsp;</p>
</c:if>

<c:if test="${not empty person.addresses}">
    <table class="search">
        <tr>
            <th><fmt:message key="address.form.address"/></th>
            <th><fmt:message key="address.form.city"/></th>
            <th><fmt:message key="address.form.state"/></th>
            <th><fmt:message key="address.form.zipPostal"/></th>
            <th><fmt:message key="address.form.country"/></th>
        </tr>
        <c:forEach var="address" items="${person.addresses}">
            <tr>
                <td>${address.address}</td>
                <td>${address.city}</td>
                <td>${address.state}</td>
                <td>${address.zipPostal}</td>
                <td>${address.country}</td>
            </tr>
        </c:forEach>
    </table>
</c:if>
The 'messages' div at the top of the page can display a status message or any Spring bind errors. The validation for address is in a method in the Address class. The method in this case is `validateAddressForm(MessageContext context)`. It is for the 'addressForm' view-state so the method name should be 'validate' + ${viewStateId} and take a MessageContext as a parameter.
3. Code Example

The person controller still handles delete and search.

```java
@Controller
class PersonController {
    final Logger logger = LoggerFactory.getLogger(getClass());

    static final String SEARCH_VIEW_PATH_KEY = "/person/search";
    private static final String DELETE_PATH_KEY = "/person/delete";
    private static final String SEARCH_VIEW_KEY = "redirect:search.html";
    private static final String SEARCH_MODEL_KEY = "persons";

    private final PersonService service;
    @Autowired
    public PersonController(PersonService service) {
        this.service = service;
    }

    /**
     * <p>Deletes a person.</p>
     * Expected HTTP POST and request '/person/delete'.
     */
    @RequestMapping(value=DELETE_PATH_KEY, method=RequestMethod.POST)
    public String delete(@RequestParam("id") Integer id) {
        logger.info("{} id={}", DELETE_PATH_KEY, id);
        service.delete(id);
        return SEARCH_VIEW_KEY;
    }

    /**
     * <p>Searches for all persons and returns them in a
     * code>Collection</code>. Expected HTTP GET and request '/person/search'.
     */

    public String search() {
        return SEARCH_VIEW_KEY;
    }
}```
Example 1 PersonController

At the end of the flow and when exception occurs that the flow doesn't handle, the PersonFlowHandler redirects to the search page.

Example 2 PersonFlowHandler

Person Validator that is automatically called by Spring Web Flow based on bean name (${model} + 'Validator') and the method based binding in a view-state.
public void validatePersonForm(Person person, MessageContext context) {
    if (!StringUtils.hasText(person.getFirstName())) {
        context.addMessage(new MessageBuilder().error().source("firstName").code("person.form.firstName.error").build());
    }
    if (!StringUtils.hasText(person.getLastName())) {
        context.addMessage(new MessageBuilder().error().source("lastName").code("person.form.lastName.error").build());
    }
}

Example 3 PersonValidator

/**
 * Validates 'addressForm' view state after binding to address.
 * Spring Web Flow activated validation ('validate' + ${state}).
 */
public void validateAddressForm(MessageContext context) {
    if (!StringUtils.hasText(address)) {
        context.addMessage(new MessageBuilder().error().source("address").code("address.form.address.error").build());
    }
    if (!StringUtils.hasText(city)) {
        context.addMessage(new MessageBuilder().error().source("city").code("address.form.city.error").build());
    }
    if (!StringUtils.hasText(state)) {
        context.addMessage(new MessageBuilder().error().source("state").code("address.form.state.error").build());
    }
    if (!StringUtils.hasText(zipPostal)) {
        context.addMessage(new MessageBuilder().error().source("zipPostal").code("address.form.zipPostal.error").build());
    }
    if (!StringUtils.hasText(country)) {
        context.addMessage(new MessageBuilder().error().source("country").code("address.form.country.error").build());
    }
}

Example 4 Excerpt from Address

4. Reference

Related Links
Project Setup

Follow the Project Checkout instructions for git, then go to the project (relative path below).

```
$ cd web/spring-webflow-subflow-webapp
```

General Setup Instructions

General instructions for checking out the project with Eclipse and building with Maven.

Example Project Setup

Project Information

- Spring Framework 3.2.x
- Spring Security 3.1.x
- Spring Web Flow 2.3.x
This is a simple Grails [http://www.grails.org/] web application with a basic form to create and edit a person and addresses.

Note


1. Create Application

Create the Grails application, domain classes, and controller classes using Grails commands.

Create the application by running the `grails create-app` command.

```
$ grails create-app simple-grails-webapp
Welcome to Grails 1.1.2 - http://grails.org/
Licensed under Apache Standard License 2.0
Grails home is set to: /usr/local/grails
Base Directory: ...
Running script /usr/local/grails/scripts/CreateApp_.groovy
Environment set to development
[mkdir] Created dir: /simple-grails-webapp/src
[mkdir] Created dir: /simple-grails-webapp/src/java
[mkdir] Created dir: /simple-grails-webapp/src/groovy
[mkdir] Created dir: /simple-grails-webapp/grails-app
[mkdir] Created dir: /simple-grails-webapp/grails-app/controllers
[mkdir] Created dir: /simple-grails-webapp/grails-app/services
[mkdir] Created dir: /simple-grails-webapp/grails-app/domain
[mkdir] Created dir: /simple-grails-webapp/grails-app/taglib
[mkdir] Created dir: /simple-grails-webapp/grails-app/utils
[mkdir] Created dir: /simple-grails-webapp/grails-app/views
[mkdir] Created dir: /simple-grails-webapp/grails-app/views/layouts
[mkdir] Created dir: /simple-grails-webapp/grails-app/views/i18n
[mkdir] Created dir: /simple-grails-webapp/grails-app/conf
[mkdir] Created dir: /simple-grails-webapp/test
[mkdir] Created dir: /simple-grails-webapp/test/unit
[mkdir] Created dir: /simple-grails-webapp/test/integration
[mkdir] Created dir: /simple-grails-webapp/scripts
[mkdir] Created dir: /simple-grails-webapp/web-app
[mkdir] Created dir: /simple-grails-webapp/web-app/js
[mkdir] Created dir: /simple-grails-webapp/web-app/css
[mkdir] Created dir: /simple-grails-webapp/web-app/images
[mkdir] Created dir: /simple-grails-webapp/web-app/META-INF
[mkdir] Created dir: /simple-grails-webapp/web-app/lib
[mkdir] Created dir: /simple-grails-webapp/grails-app/conf/spring
[propertyfile] Creating new property file: /simple-grails-webapp/application.properties
[copy] Copying 1 resource to /simple-grails-webapp
[unjar] Expanding: /simple-grails-webapp/grails-shared-files.jar into /simple-grails-webapp
```
Move to the directory of the newly created project and create the `Person` domain class using `grails create-domain-class`.

```
$ cd simple-grails-webapp

$ grails create-domain-class Person
```

Create the `Address` domain class.

```
$ grails create-domain-class Address
```

Create the `PersonController` using the `grails create-controller` command.

```
$ grails create-controller Person
```
Create the AddressController.

$ grails create-controller Address

Welcome to Grails 1.1.2 - http://grails.org/
Licensed under Apache Standard License 2.0
Grails home is set to: /usr/local/grails

Base Directory: /simple-grails-webapp
Running script /usr/local/grails/scripts/CreateController.groovy
Environment set to development
Created Controller for Address
[mkdir] Created dir: /simple-grails-webapp/grails-app/views/address
Created Tests for Address

2. Modify Code

Edit the generated Grails domain and controller classes. This will add fields and validation rules to the domain classes, and activate scaffolding in the controller classes. Grails’ scaffolding automatically generates a controller and JSP pages that work with the associated domain class.

First add a first name, last name, created, and list of addresses to Person. By assigning the hasMany field to [addresses:Address], this creates a relationship to Address with an addresses list variable. The constraints section is where validation rules can be set. All the fields are set to not allow null values.

Edit grails-app/domain/Person.groovy to match the code below.

```groovy
class Person {  
    String firstName
    String lastName
    List<Address> addresses
    Date created

    static hasMany = [addresses:Address]

    static constraints = {
        firstName(nullable:false)
        lastName(nullable:false)
        created(nullable:false)
    }
}  
```

Example 1 Person
Next, add the basic fields to `Address` and define that it is the many part of a one-to-many relationship to `Person` by assigning the `belongsTo` field to `Person`.

Edit `grails-app/domain/Address.groovy` to match the code below.

```groovy
class Address {
    String address
    String city
    String state
    String zipPostal
    String country
    Date created

    static belongsTo = Person

    static constraints = {
        address(nullable:false)
        city(nullable:false)
        state(nullable:false)
        zipPostal(nullable:false)
        country(nullable:false)
        created(nullable:false)
    }
}
```

**Example 2 Address**

Now that the domain objects are setup, the controllers will be set to use Grails' scaffolding. This will autogenerate the controller interface and basic JSP pages. The `scaffold` variable just needs to be set to `true` and Grails will handle everything else. The `PersonController` is automatically associated with the `Person` domain class based on default naming conventions.

Edit `grails-app/controllers/PersonController.groovy` to match the code below.

```groovy
class PersonController {
    def scaffold = true
}
```

**Example 3 PersonController**

Activate scaffolding for the `AddressController`.

Edit `grails-app/controllers/AddressController.groovy` to match the code below.

```groovy
class AddressController {
    def scaffold = true
}
```
Example 4 AddressController

3. Run Application

Start the application by running the `grails run-app` command.

```bash
$ grails run-app
Welcome to Grails 1.1.2 - http://grails.org/
Licensed under Apache Standard License 2.0
Grails home is set to: /usr/local/grails
Base Directory: /simple-grails-webapp
Running script /usr/local/grails/scripts/RunApp.groovy
Environment set to development
  [mkdir] Created dir: ~/.grails/1.1.2/projects/simple-grails-webapp/classes
  [groovyc] Compiling 10 source files to ~/.grails/1.1.2/projects/simple-grails-webapp/classes
  [mkdir] Created dir: ~/.grails/1.1.2/projects/simple-grails-webapp/resources/grails-app/i18n
[native2ascii] Converting 11 files from /simple-grails-webapp/grails-app/i18n to
  ~/.grails/1.1.2/projects/simple-grails-webapp/resources/grails-app/i18n
  [copy] Copying 1 file to ~/.grails/1.1.2/projects/simple-grails-webapp/resources
  [copy] Copied 2 empty directories to 2 empty directories under
  ~/.grails/1.1.2/projects/simple-grails-webapp/resources
Running Grails application..
```

Navigating to the application’s home page, there will be a link to the person and address controllers. After creating and address, from the person page the address can be associated with the person. The application is very basic, but it's functional and was made very quickly.

4. Reference

Related Links

- Grails [http://www.grails.org/]

Project Setup

Follow the Project Checkout instructions for git, then go to the project (relative path below).

```bash
$ cd web/simple-grails-webapp
```

General Setup Instructions
General instructions for checking out the project with Eclipse and building with Maven.

Example Project Setup

**Project Information**

- Grails 1.1.x
Simple Flex Webapp

David Winterfeldt

2009

The simple Flex [http://www.adobe.com/products/flex/] webapp is based on the Simple Spring MVC Form Annotation Configuration Webapp. It's the same except the HTML results on the search page have been replaced with a Flex [http://www.adobe.com/products/flex/] application and services for Flex [http://www.adobe.com/products/flex/] were configured on the server using Spring BlazeDS Integration [http://www.springsource.org/spring-flex] and Adobe BlazeDS.


Note

The project is configured with Flex Builder (Eclipse plugin) and also can be run from the command line.

$ mvn jetty:run

1. Web Configuration

This is a standard Spring web application configuration except a DispatcherServlet specifically for handling Flex [http://www.adobe.com/products/flex/] remoting requests has been added and the Spring config specified will configure Spring BlazeDS Integration [http://www.springsource.org/spring-flex].

/WEB-INF/web.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<web-app
    xmlns="http://java.sun.com/xml/ns/javaee"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://java.sun.com/xml/ns/javaee
    http://java.sun.com/xml/ns/javaee/web-app_3_0.xsd"
    version="3.0" metadata-complete="true">
  <display-name>simple-form</display-name>

  <listener>
    <listener-class>
      org.springframework.web.context.ContextLoaderListener
    </listener-class>
  </listener>

  <context-param>
    <param-name>contextConfigLocation</param-name>
    <param-value>
      /WEB-INF/*-context.xml
    </param-value>
  </context-param>
</web-app>
```
<filter>
    <filter-name>encoding-filter</filter-name>
    <filter-class>org.springframework.web.filter.CharacterEncodingFilter</filter-class>
    <init-param>
        <param-name>encoding</param-name>
        <param-value>UTF-8</param-value>
    </init-param>
</filter>

<filter-mapping>
    <filter-name>encoding-filter</filter-name>
    <url-pattern>/*</url-pattern>
</filter-mapping>

<servlet>
    <servlet-name>simple-form</servlet-name>
    <servlet-class>org.springframework.web.servlet.DispatcherServlet</servlet-class>
    <init-param>
        <param-name>contextConfigLocation</param-name>
        <param-value></param-value>
    </init-param>
</servlet>

<servlet>
    <servlet-name>spring-flex</servlet-name>
    <servlet-class>org.springframework.web.servlet.DispatcherServlet</servlet-class>
    <init-param>
        <param-name>contextConfigLocation</param-name>
        <param-value>/WEB-INF/spring/flex/flex-servlet-context.xml</param-value>
    </init-param>
    <load-on-startup>1</load-on-startup>
</servlet>

<servlet-mapping>
    <servlet-name>simple-form</servlet-name>
    <url-pattern>*.html</url-pattern>
</servlet-mapping>

<servlet-mapping>
    <servlet-name>spring-flex</servlet-name>
    <url-pattern>/spring/*</url-pattern>
</servlet-mapping>

<welcome-file-list>
    <welcome-file>index.jsp</welcome-file>
</welcome-file-list>

1. Spring BlazeDS Integration servlet.
2. Mapping Spring BlazeDS Integration servlet to handle all requests to '/spring/*'.

### 2. Spring Configuration

Setting up the Spring BlazeDS Integration [http://www.springsource.org/spring-flex] configuration is very simple. The `flex:message-broker` initializes BlazeDS and it's configuration files, which by default are expected in...
'/WEB-INF/flex' and for the main configuration to be called 'services-config.xml'. Two services are loaded, 'personRepository' and 'personService'. It's not best practice to expose the DAO directly as a service, but for this example it was done to illustrate exposing a remoting service using annotations and the custom namespace. One from the context:component-scan and the other is exposed using the Spring BlazeDS Integration [http://www.springsource.org/spring-flex] custom namespace. The PersonService exposed through scanning will be shown later in the Code Example section, and the JPA Person DAO is exposed using flex:remoting-destination. It's created just by referencing the Person DAO. To have a remoting destination name other than the bean name the destination-id could specify something different.

/WEB-INF/spring/flex/flex-servlet-context.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:p="http://www.springframework.org/schema/p"
    xmlns:context="http://www.springframework.org/schema/context"
    xmlns:flex="http://www.springframework.org/schema/flex"
    xsi:schemaLocation="http://www.springframework.org/schema/beans
    http://www.springframework.org/schema/beans/spring-beans.xsd
    http://www.springframework.org/schema/context
    http://www.springframework.org/schema/context/spring-context.xsd
    http://www.springframework.org/schema/flex
    http://www.springframework.org/schema/flex/spring-flex-1.5.xsd">
  <context:component-scan base-package="org.springbyexample.web.service"/>
  <flex:message-broker/>
  <flex:remoting-destination ref="personRepository"/>
</beans>
```

1. Spring BlazeDS Integration configuration of the BlazeDS message broker, which handles remoting and messaging requests.
2. Exposes the personRepository bean as a BlazeDS remoting destination.

3. Adobe BlazeDS Configuration

The BlazeDS configuration first imports the 'remoting-config.xml' and sets up a default channel called 'person-amf'. Then in the channels section, it's URL and the class that will handle requests to the URL is configured. The parameters in the URL 'server.name' and 'server.port' are supplied by the Flex runtime. The 'context.root' parameter needs to be supplied during compilation using the 'context-root' compiler option.

/WEB-INF/flex/services-config.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<services-config>
  <services>
    <service-include file-path="remoting-config.xml"/>
  </services>
  <default-channels>
    <channel ref="person-amf"/>
  </default-channels>
</services-config>
```
A JavaAdapter is configured to handle remoting requests. The 'person-amf' channel configured in the main config is set as the default channel. If Spring weren’t used, remote services would be configured here.

/WEB-INF/flex/remoting-config.xml
4. Code Example

This is the other remoting service previously mentioned. It's picked up by the context:component-scan because of the Service annotation and exposed as a Flex [http://www.adobe.com/products/flex/] remoting service because of the RemotingDestination annotation. The service exposed is 'personService' based on the class name, but if a value could be passed into the Service annotation to expose it under a different name (ex: @Service("otherService")) To explicitly expose or hide methods the annotations RemotingInclude and RemotingExclude can be used.

**Note**

Trying to pass the Person instance returned from a remote request directly into the Person DAO's delete would cause an error since it's missing information woven into the class by the JPA implementation for the one to many relationship with Address.

```java
@Service
@RemotingDestination
public class PersonService {
    private final PersonRepository repository;

    @Autowired
    public PersonService(PersonRepository repository) {
        this.repository = repository;
    }

    /**
     * <p>Deletes person.</p>
     * <p>Note: Passing back the person from the Flex client causes a problem with Hibernate.</p>
     */
    public void remove(int id) {
        repository.delete(id);
    }
}
```

*Example 1 PersonService*

5. Flex Code Example

This section will go over the code for the Flex [http://www.adobe.com/products/flex/] search page. It will cover remoting, the UI, internationalization (i18n), and logging. Parts of the application use the Flex [http://www.adobe.com/products/flex/] MVC framework from Adobe called Cairngorm [http://opensource.adobe.com/wiki/display/cairngorm/]. The model, view, and controller are all in the ActionScript code and helps separate business logic from the UI components.

**Note**

```
-locale=en_US,es_ES -source-path=../locales/{locale}
```
These additional compiler arguments are necessary when building the Flex [http://www.adobe.com/products/flex/] part of the example. The 'locale' option specifies that both the 'en_US' and 'es_ES' locales should be compiled into the binary. The 'source-path' option indicates where the different locales properties files should be found. To use locales other than english (en_US) a command must be run for the Flex SDK to copy the default locale of 'en_US' to create the new locale.

```
$ /Applications/Adobe/Flex/Builder/3/Plug-in/sdks/3.2.0/bin/copylocale en_US es_ES
```

The 'context-root' is the web applications context path and is used as a variable in the 'services-config.xml' when defining the remoting channel's URL. The 'compiler.services' option points to the location of the BlazeDS configuration. The different channels defined are compiled into the binary, so when a RemoteObject is defined in the code below it isn't necessary to specify it's endpoint.

The 'search.mxml' is the entry point for the Flex [http://www.adobe.com/products/flex/] application. So it's main enclosing element is mx:Application. In Flex [http://www.adobe.com/products/flex/] components can either be made in mxml files or ActionScript files. It configures the mx namespace (Flex [http://www.adobe.com/products/flex/] components) and controller namespace (applicaton specific classes). The layout is set to 'horizontal', but isn't important since there is just one component displayed. There are multiple events during the components initialization that can have callbacks registered with them. The 'initialize' and 'addedToStage' events are used here. The mx:Metadata element loads the 'messages' resource bundles. The controller namespace is used to instantiate the application's two Cairngorm [http://opensource.adobe.com/wiki/display/cairngorm/] controllers.

The mx:Script element contains ActionScript. At the beginning of it are imports just like in Java. Below that fields for the logging are defined. Underneath that are the two methods for handling initialization events and a key down handler for the logging window. During initialization logging is setup with the application's log target and the logging window is initialized. The Cairngorm [http://opensource.adobe.com/wiki/display/cairngorm/] events for initializing the locale from the server and the initial data for search are dispatched as well as setting the model for the search results to the DataGrid. The added to stage event sets up a key down handler to hide and show the logging window when 'ctrl + shift + up' is pressed.

The mx:DataGrid is the display component for search. If columns weren't explicitly defined, the data would still be shown but the property name would be used for the header. By using the mx:DataGridColumn element the columns being shown and the i18n column name is used. Also the third column is a custom renderer that creates an edit and delete button for each row. The edit button redirects to the edit page using the navigateToURL method, and delete sends a request to the person service.

```
<?xml version="1.0" encoding="utf-8"?>
 xmlns:controller="org.springbyexample.web.flex.controller.*"
 layout="horizontal"
 initialize="initializeHandler()"
 addedToStage="addedToStageHandler()">
```
To use other locales besides en_US, the en_US locale must be copied in the sdk.

ex: /Applications/Adobe\ Flex\ Builder\ 3\ Plug-in/sdks/3.2.0/bin/copylocale en_US en_ES

```xml
<mx:Metadata>

[ResourceBundle("messages")]
</mx:Metadata>

<controller:ResourceController/>
<controller:PersonController/>

<mx:Script>

<![CDATA[
import org.springbyexample.web.flex.log.LogWindow;
import mx.logging.Log;
import mx.logging.ILogger;
import org.springbyexample.web.flex.event/localeChangeEvent;
import org.springbyexample.web.flex.event.PersonSearchEvent;
import org.springbyexample.web.flex.log.StringBufferTarget;
import org.springbyexample.web.flex.model.PersonSearchModelLocator;

private const logger:ILogger = Log.getLogger("search.mxm1");
private var logTarget: StringBufferTarget = new StringBufferTarget();
private var logWindow: LogWindow;

/**
 * Initialize component.
 */
private function initializeHandler(): void {
  Log.addTarget(logTarget);
  logWindow = new LogWindow()
  logWindow.logTarget = logTarget;
  var lce:LocaleChangeEvent = new LocaleChangeEvent(resourceManager);
  lce.dispatchEvent();
  var psml:PersonSearchModelLocator = PersonSearchModelLocator.getInstance();
  searchDataGrid.dataProvider = psml.personData;
  var pse:PersonSearchEvent = new PersonSearchEvent();
  pse.dispatchEvent();
}

/**
 * Handles the 'addedToStage' event.
 */
private function addedToStageHandler(): void {
  stage.addEventListener(KeyboardEvent.KEY_DOWN, keydownHandler);
}

/**
 * Handles key down event. Toggles showing the log text area if 'ctrl + shift + up' is pressed.
 */
private function keydownHandler(event: KeyboardEvent): void {
  if (event.ctrlKey && event.shiftKey && event.keyCode == Keyboard.UP) {
    if (logWindow.active) {
      logWindow.hide();
    } else {
      logWindow.open(this);
    }
  }
}]]>
</mx:Script>
```

Example 2 search.mxml

1. Loads all locale resource bundles that start with 'messages' (all 'messages.properties' resource bundles).
2. Configures a logger.
3. Initialization callback handler that configures logging with the application's log target, initializes the log window, dispatch the LocaleChangeEvent to get the locale from the server and set the matching one in the client, sets the Person model to the search DataGrid, and dispatch the PersonSearchEvent to get the search data from the server and initialize the search DataGrid.
4. The search DataGrid that displays the search results.
5. Defines the column for the 'firstName' field and retrieves the header from the resource manager's 'messages' bundle using the 'person.form.firstName' key.
6. Defines the column for the 'lastName' field and retrieves the header from the resource manager's 'messages' bundle using the 'person.form.lastName' key.
7. Creates a custom renderer for the third column that has an edit and delete button for the current row. The edit button redirects to the HTML edit page. The delete button sends a request to the server and removes the row from the UI.

The Person ActionScript class is very similar to a Java class. A package is defined, imports, and a class that can contain variables and functions. The class has RemoteClass metadata set on it indicating that if the org.springbyexample.web.jpa.bean.Person Java class is serialized by either a remoting or a messaging request, Flex [http://www.adobe.com/products/flex/] will bind the incoming data to the matching ActionScript class. More can be read about the mapping between ActionScript and Java at Explicitly mapping ActionScript and Java objects [http://livedocs.adobe.com/blazeds/1/blazeds_devguide/help.html?content=serialize_data_3.html].
package org.springbyexample.web.jpa.bean {
import mx.collections.ArrayCollection;

/**
 * <p>Person information which binds to the Java
 * remote class <code>org.springbyexample.web.jpa.bean.Person</code>.</p>
 *
 * @author David Winterfeldt
 */
[RemoteClass(alias="org.springbyexample.web.jpa.bean.Person")]
public class Person {
    public var id:int;
    public var firstName:String;
    public var lastName:String;
    public var addresses:ArrayCollection;
    public var created:Date;
}
}

Example 3 Person

This is the Cairngorm [http://opensource.adobe.com/wiki/display/cairngorm/] model. The PersonSearchModelLocator has the metadata value [Bindable] set on it. This indicates that any changes to values in this class will fire events to anything a value is bound to. In this case the search DataGrid is bound to the personData ArrayCollection so when the controller updates the data, the DataGrid is automatically updated.

The PersonSearchModelLocator is using the standard singleton pattern, but ideally a Dependency Injection (DI) framework would be used instead to inject the model where it's needed. This wasn't done to keep this example simpler, and this is actually the suggested way to create a model in Cairngorm [http://opensource.adobe.com/wiki/display/cairngorm/]. There are multiple DI frameworks are available. Two are Parsley [http://www.spicefactory.org/parsley/] and Spring ActionScript [http://www.springactionscript.org/]. Spring ActionScript [http://www.springactionscript.org/] is a SpringSource sponsored project.

[Bindable]
public class PersonSearchModelLocator implements ModelLocator {
    public var personData:ArrayCollection = new ArrayCollection();
    private static var _instance:PersonSearchModelLocator = null;
    /**
     * Implementation of <code>ModelLocator</code>. 
     */
    public static function getInstance():PersonSearchModelLocator {
        if (_instance == null) {
            _instance = new PersonSearchModelLocator();
        }
        return _instance;
    }
}
Example 4 PersonSearchModelLocator

This is the custom Cairngorm [http://opensource.adobe.com/wiki/display/cairngorm/] event for retrieving person search data. As was seen in 'search.mxml' an instance of the event can be created and dispatch can then be called on it.

```java
public class PersonSearchEvent extends CairngormEvent {
    public static var EVENT_ID:String = "org.springbyexample.web.flex.event.PersonSearchEvent";

    /**
     * Constructor
     */
    public function PersonSearchEvent() {
        super(EVENT_ID);
    }
}
```

Example 5 PersonSearchEvent

The PersonController is a front controller and allows mapping of custom events to command implementations for the events.

```java
public class PersonController extends FrontController {

    /**
     * Constructor
     */
    public function PersonController() {
        super();
        addCommand(PersonSearchEvent.EVENT_ID, PersonSearchCommand);
        addCommand(PersonDeleteEvent.EVENT_ID, PersonDeleteCommand);
    }
}
```

Example 6 PersonController

The PersonSearchCommand was associated with the PersonSearchEvent in the PersonController. In execute(event:CairngormEvent), which is the implementation of ICommand, a remoting request to the 'personRepository' service is made. A RemoteObject is created passing in the name of the service, and the method matching the Java class on the server is called. It's very simple and straightforward. An event listener is attached to the RemoteObject to listen for a result. An event listener could also be registered to listen for a failure. Flex [http://www.adobe.com/products/flex/] has an excellent event model that is easy to leverage for custom
events.

```
public class PersonSearchCommand implements ICommand {
    /**
     * Implementation of <code>ICommand</code>.
     */
    public function execute(event:CairngormEvent):void {
        var ro:RemoteObject = new RemoteObject("personRepository");
        ro.findAll();
        ro.addEventListener(ResultEvent.RESULT, updateSearch);
    }

    /**
     * Updates search.
     */
    private function updateSearch(event:ResultEvent):void {
        var psml:PersonSearchModelLocator = PersonSearchModelLocator.getInstance();
        psml.personData.source = (event.result as ArrayCollection).source;
    }
}
```

**Example 7 PersonSearchCommand**

The **PersonDeleteCommand** was associated with the **PersonDeleteEvent** in the **PersonController**. It retrieves the person id from the event and makes a delete request to the server. Upon success a **PersonSearchEvent** is fired to display the latest data in the search results. It would be more efficient to just remove the row from the **ArrayCollection**, but this was done to illustrate how easy it is to perform different tasks in the application once everything is cleanly decoupled using MVC.

```
public class PersonDeleteCommand implements ICommand {
    private const logger:ILogger = Log.getLogger("org.springbyexample.web.flex.controller.command.PersonDeleteCommand");
    /**
     * Implementation of <code>ICommand</code>.
     */
    public function execute(event:CairngormEvent):void {
        var pde:PersonDeleteEvent = event as PersonDeleteEvent;
        var id:int = pde.id;
        logger.info("Delete person. id=" + id);
        var ro:RemoteObject = new RemoteObject("personService");
        ro.remove(id);
        ro.addEventListener(ResultEvent.RESULT, updateSearch);
    }

    /**
     * Updates search.
     */
    private function updateSearch(event:ResultEvent):void {
        var pse:PersonSearchEvent = new PersonSearchEvent();
        pse.dispatch();
    }
}
```
6. Reference

Related Links

- Adobe Flex [http://www.adobe.com/products/flex/]
- Spring BlazeDS Integration [http://www.springsource.org/spring-flex]
- Adobe BlazeDS [http://sourceforge.net/adobe/blazeds/wiki/Home/]
- Adobe Cairngorm [http://sourceforge.net/adobe/cairngorm/home/Home/]

Project Setup

Follow the Project Checkout instructions for git, then go to the project (relative path below).

$ cd flex/simple-flex-webapp

General Setup Instructions

General instructions for checking out the project with Eclipse and building with Maven.

Example Project Setup

Project Information

- Spring Framework 3.2.x
- Spring BlazeDS Integration 1.5.x
Part V. Enterprise

Enterprise examples.
This is a very simple example using a Spring JMS Template to send messages and also having a JMS listener process the messages sent. An embedded ActiveMQ instance is used as the broker.

1. Producer Configuration

Spring Configuration

The Spring configuration shows a `context:component-scan` that picks up the JMS producer and listener. Following this the Spring custom namespace for Apache's ActiveMQ is used to create an embedded JMS broker. A queue is configured for 'org.springbyexample.jms.test'. Then a JMS connection factory is made for the JmsTemplate to use. The template will be used by the producer to send messages.

Excerpt from `JmsMessageListenerTest-context.xml`

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:p="http://www.springframework.org/schema/p"
    xmlns:context="http://www.springframework.org/schema/context"
    xmlns:jms="http://www.springframework.org/schema/jms"
    xmlns:amq="http://activemq.apache.org/schema/core"
    xsi:schemaLocation="http://www.springframework.org/schema/beans
    http://www.springframework.org/schema/beans/spring-beans.xsd
    http://www.springframework.org/schema/context
    http://www.springframework.org/schema/context/spring-context.xsd
    http://www.springframework.org/schema/jms
    http://www.springframework.org/schema/jms/spring.jms.xsd
    http://activemq.apache.org/schema/core
    http://activemq.apache.org/schema/core/activemq-core.xsd">
    <context:component-scan base-package="org.springbyexample.jms" />
    <!-- Embedded ActiveMQ Broker -->
    <amq:broker id="broker" useJmx="false" persistent="false">
        <amq:transportConnectors>
            <amq:transportConnector uri="tcp://localhost:0" />
        </amq:transportConnectors>
    </amq:broker>
    <!-- ActiveMQ Destination -->
    <amq:queue id="destination" physicalName="org.springbyexample.jms.test" />
    <!-- JMS ConnectionFactory to use, configuring the embedded broker using XML -->
    <amq:connectionFactory id="jmsFactory" brokerURL="vm://localhost" />
    <!-- JMS Producer Configuration -->
    <bean id="jmsProducerConnectionFactory"
        class="org.springframework.jms.connection.SingleConnectionFactory"
        depends-on="broker"
        p:targetConnectionFactory-ref="jmsFactory" />
</beans>
```
Code Example

The producer uses @PostConstruct to indicate that generateMessages() is an initialization method. It uses the JmsTemplate to send text messages and also sets an int property for the message count.

```
@Component
public class JmsMessageProducer {
    private static final Logger logger = LoggerFactory.getLogger(JmsMessageProducer.class);
    protected static final String MESSAGE_COUNT = "messageCount";
    @Autowired
    private JmsTemplate template = null;
    private int messageCount = 100;
    /**
     * Generates JMS messages
     */
    @PostConstruct
    public void generateMessages() throws JMSException {
        for (int i = 0; i < messageCount; i++) {
            final int index = i;
            final String text = "Message number is " + i + ".";
            template.send(new MessageCreator() {
                public Message createMessage(Session session) throws JMSException {
                    TextMessage message = session.createTextMessage(text);
                    message.setIntProperty(MESSAGE_COUNT, index);
                    logger.info("Sending message: "+ text);
                    return message;
                }
            });
        }
    }
}
```

Example 1 JmsMessageProducer

2. Client Configuration
Spring Configuration

This shows configuring the JMS listener using Spring's jms custom namespace. The jmsMessageListener bean was loaded by the context:component-scan and implements MessageListener. If it didn't the jms:listener element could specify which method should process a message from the queue. The jms:listener specifies the destination attribute to be 'org.springbyexample.jms.test', which matches the queue defined by the amq:queue element in the embedded ActiveMQ configuration.

The AtomicInteger is used by the listener to increment how many messages it processes, and is also used by the unit test to confirm is received all the messages from the producer.

Excerpt from JmsMessageListenerTest-context.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:p="http://www.springframework.org/schema/p"
  xmlns:context="http://www.springframework.org/schema/context"
  xmlns:jms="http://www.springframework.org/schema/jms"
  xmlns:amq="http://activemq.apache.org/schema/core"
  xsi:schemaLocation="http://www.springframework.org/schema/beans
  http://www.springframework.org/schema/beans/spring-beans.xsd
  http://www.springframework.org/schema/context
  http://www.springframework.org/schema/context/spring-context.xsd
  http://www.springframework.org/schema/jms
  http://www.springframework.org/schema/jms/spring-jms.xsd
  http://activemq.apache.org/schema/core
  http://activemq.apache.org/schema/core/activemq-core.xsd">
  <context:component-scan base-package="org.springbyexample.jms" />
  ...
  <!-- JMS Consumer Configuration -->
  <bean id="jmsConsumerConnectionFactory"
    class="org.springframework.jms.connection.SingleConnectionFactory"
    depends-on="broker"
    p:targetConnectionFactory-ref="jmsFactory" />
  <jms:listener-container container-type="default"
    connection-factory="jmsConsumerConnectionFactory"
    acknowledge="auto">
    <jms:listener destination="org.springbyexample.jms.test" ref="jmsMessageListener" />
  </jms:listener-container>
  <!-- Counter for consumer to increment and test to verify count -->
  <bean id="counter" class="java.util.concurrent.atomic.AtomicInteger" />
</beans>
```

Code Example

The JmsMessageListener implements the JMS interface MessageListener. The int property for the message count can be retrieved before casting the message to TextMessage. Then the message and message count are both logged.
Example 2 JmsMessageListener

3. Reference

Related Links

- Spring 3.2.x JMS Documentation [http://static.springsource.org/spring/docs/3.2.x/spring-framework-reference/html/jms.html]
- Java Message Service (JMS) [http://www.oracle.com/technetwork/java/jms/index.html]
- Apache ActiveMQ [http://activemq.apache.org/]
- Apache ActiveMQ Spring Support Documentation [http://activemq.apache.org/spring-support.html]

Project Setup

Follow the Project Checkout instructions for git, then go to the project (relative path below).

$ cd enterprise/simple-spring-jms
General Setup Instructions

General instructions for checking out the project with Eclipse and building with Maven.

Example Project Setup

**Project Information**

- Spring Framework 3.2.x
Simple Spring Web Services using JAXB for Marshalling

David Winterfeldt

2008

A very simple example of using Spring Web Services 2.1.x with JAXB for marshalling and unmarshalling requests. A JAXB plugin for Maven is used to generate the JAXB beans from and XSD and the XSD is reused to generate a WSDL. The response from the server sends a person list, but could easily be modified to retrieve person based on an ID.

1. Server Configuration

Web Configuration

The MessageDispatcherServlet needs to be defined and the URL patterns it will handle. The contextConfigLocation is specified instead of allowing the default (/WEB-INF/spring-ws-servlet.xml) because this location makes the configuration easier to share with the unit test.

/WEB-INF/web.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<web-app xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
         xmlns="http://java.sun.com/xml/ns/javaee"
         xmlns:web="http://java.sun.com/xml/ns/javaee/web-app_2_5.xsd"
         xsi:schemaLocation="http://java.sun.com/xml/ns/javaee
                          http://java.sun.com/xml/ns/javaee/web-app_2_5.xsd"
         id="WebApp_ID" version="2.5">
  <servlet>
    <servlet-name>spring-ws</servlet-name>
    <servlet-class>org.springframework.ws.transport.http.MessageDispatcherServlet</servlet-class>
    <init-param>
      <param-name>contextConfigLocation</param-name>
      <param-value>classpath:/spring-ws-context.xml</param-value>
    </init-param>
  </servlet>
  <servlet-mapping>
    <servlet-name>spring-ws</servlet-name>
    <url-pattern>/*</url-pattern>
  </servlet-mapping>
</web-app>
```

Spring Configuration
The **PersonEndpoint** is defined as a bean and will automatically be registered with Spring Web Services since the class is identified as an endpoint by the [@Endpoint](#) annotation. This configuration uses the person.xsd that was used to generate the JAXB beans to generate the WSDL. The locationUri matches the URL pattern specified in the web.xml.

The JAXB marshaller/unmarshaller is configured using Spring OXM and also set on the [MarshallingMethodEndpointAdapter](#) bean.

/src/main/resources/spring-ws-context.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:p="http://www.springframework.org/schema/p"
  xmlns:context="http://www.springframework.org/schema/context"
  xsi:schemaLocation="http://www.springframework.org/schema/beans
  http://www.springframework.org/schema/beans/spring-beans.xsd
  http://www.springframework.org/schema/context
  http://www.springframework.org/schema/context/spring-context.xsd">
  <context:component-scan base-package="org.springbyexample.ws.service" />
  <bean id="person" class="org.springframework.ws.wsdl.wsdl11.DefaultWsdl11Definition"
    p:portTypeName="Person"
    p:locationUri="/personService/"
    p:requestSuffix="-request"
    p:responseSuffix="-response">
    <property name="schema">
      <bean class="org.springframework.xml.xsd.SimpleXsdSchema"
        p:xsd="classpath:/person.xsd" />
    </property>
  </bean>
  <bean class="org.springframework.ws.server.endpoint.mapping.PayloadRootAnnotationMethodEndpointMapping">
    <description>An endpoint mapping strategy that looks for @Endpoint and @PayloadRoot annotations.</description>
  </bean>
  <bean class="org.springframework.ws.server.endpoint.adapter.MarshallingMethodEndpointAdapter">
    <description>Enables the MessageDispatchServlet to invoke methods requiring OXM marshalling.</description>
    <constructor-arg ref="marshaller" />
  </bean>
  <bean id="marshaller" class="org.springframework.oxm.jaxb.Jaxb2Marshaller"
    p:contextPath="org.springbyexample.person.schema.beans" />
</beans>
```

### XML Schema Descriptor

A very simple XSD defining an element to indicate an incoming request to get all persons (name element isn't used) and a person response element that contains a list of person elements.

**person.xsd**
Code Example

Interface for getting persons using the JAXB generated beans ('get-persons-request' element --> GetPersonsRequest?, 'person-response' element --> PersonResponse?). It also has constants for the namespace (matches XSD) and a request constant.

```
public interface MarshallingPersonService {
    public final static String NAMESPACE = "http://www.springbyexample.org/person/schema/beans";
    public final static String GET_PERSONS_REQUEST = "get-persons-request";

    /**
     * Gets person list.
     * @param request
     * @return
     */
    public PersonResponse getPersons(GetPersonsRequest request);
}
```

*Example 1 MarshallingPersonService*

It is indicated as an endpoint by the @Endpoint annotation and implements MarshallingPersonService. The getPersons method is indicated to handle a specific namespace and incoming request element.
The endpoint just prepares a static response, but this could very easily have a DAO injected into it and information retrieved from a database that is then mapped into the JAXB beans. The `PersonResponse` is created using the JAXB Fluent API which is less verbose than the standard JAXB API.

```java
@Endpoint
public class PersonEndpoint implements MarshallingPersonService {

/**
 * Gets person list.
 */
@PayloadRoot(localPart=GET_PERSONS_REQUEST, namespace=NAMESPACE)
public PersonResponse getPersons(GetPersonsRequest request) {
    return new PersonResponse().withPerson(
        new Person().withId(1).withFirstName("Joe").withLastName("Smith"),
        new Person().withId(2).withFirstName("John").withLastName("Jackson"));
}
}
```

Example 2 PersonEndpoint

## 2. Client Configuration

### Spring Configuration

The `org.springbyexample.ws.service` package is scanned for beans and will find the `PersonServiceClient` and inject the `WebServiceTemplate` into it. The JAXB marshaller/unmarshaller is defined and set on the template.

The import of the `jetty-context.xml` isn't relevant to creating a client, but it creates an embedded jetty instance that loads the `spring-ws-context.xml` and it's services. Then client in the unit test is able to run in isolation.

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:p="http://www.springframework.org/schema/p"
    xmlns:context="http://www.springframework.org/schema/context"
    xsi:schemaLocation="http://www.springframework.org/schema/beans
    http://www.springframework.org/schema/beans/spring-beans.xsd
    http://www.springframework.org/schema/context
    http://www.springframework.org/schema/context/spring-context.xsd">
    <import resource="jetty-context.xml"/>
    <context:component-scan base-package="org.springbyexample.ws.client" />
    <context:property-placeholder location="org/springbyexample/ws/client/ws.properties"/>
    <bean id="personWsTemplate" class="org.springframework.ws.client.core.WebServiceTemplate" p:defaultUri="http://${ws.host}:${ws.port}/${ws.context.path}/personService/"
        p:marshaller-ref="marshaller"
        p:unmarshaller-ref="marshaller" />
```

Example 2 PersonEndpoint
Code Example

At this point Spring Web Services handle almost everything. The template just needs to be called and it will return the PersonResponse from the service endpoint. The client can be used like this:

```java
PersonResponse response = client.getPersons(new GetPersonsRequest());
```

```java
public class PersonServiceClient implements MarshallingPersonService {
    @Autowired
    private WebServiceTemplate wsTemplate;

    /**
     * Gets person list.
     */
    public PersonResponse getPersons(GetPersonsRequest request) {
        PersonResponse response = (PersonResponse) wsTemplate.marshalSendAndReceive(request);
        return response;
    }
}
```

Example 3 PersonServiceClient

3. Unit Test

Spring Configuration

The unit test's main XML configuration was shown in the Client Spring Configuration section, but this is the configuration that it imported. It creates an embedded Jetty instance and registers the Spring Web Service MessageDispatcherServlet. The spring-ws-context.xml configuration is passed into the servlet.

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:p="http://www.springframework.org/schema/p"
    xmlns:context="http://www.springframework.org/schema/context"
    xsi:schemaLocation="http://www.springframework.org/schema/beans
    http://www.springframework.org/schema/beans/spring-beans.xsd
    http://www.springframework.org/schema/context
    http://www.springframework.org/schema/context
    http://www.springframework.org/schema/context"/>
```
<beans>
  <context:property-placeholder location="org/springbyexample/ws/client/ws.properties"/>
  <bean id="jettyServer"
    class="org.mortbay.jetty.Server"
    init-method="start" destroy-method="stop">
    <property name="threadPool">
      <bean id="ThreadPool"
        class="org.mortbay.thread.concurrent.ThreadPool">
        <constructor-arg value="0"/>
      </bean>
    </property>
    <property name="connectors">
      <list>
        <bean id="Connector"
          class="org.mortbay.jetty.nio.SelectChannelConnector"
          p:port="${ws.port}" p:maxIdleTime="30000" p:acceptors="2" p:confidentialPort="8443"/>
      </list>
    </property>
    <property name="handlers">
      <list>
        <bean class="org.mortbay.jetty.servlet.Context"
          p:contextPath="/${ws.context.path}"
          <property name="sessionHandler">
          <bean class="org.mortbay.jetty.servlet.SessionHandler"/>
        </property>
        <property name="servletHandler">
          <bean class="org.mortbay.jetty.servlet.ServletHandler">
            <property name="servlets">
              <list>
                <bean class="org.mortbay.jetty.servlet.ServletHolder"
                  p:name="spring-ws">
                  <property name="servlet">
                    <bean
                      class="org.springframework.ws.transport.http.MessageDispatcherServlet"/>
                  </property>
                </bean>
                <bean class="org.springframework.ws.transport.http.MessageDispatcherServlet"/>
              </list>
            </property>
          </bean>
        </property>
        <property name="servletMappings">
          <list>
            <bean class="org.mortbay.jetty.servlet.ServletMapping"
              p:servletName="spring-ws" p:pathSpec="/*"/>
          </list>
        </property>
        <bean class="org.mortbay.jetty.handler.DefaultHandler"/>
        <bean class="org.mortbay.jetty.handler.RequestLogHandler"/>
      </list>
    </property>
  </bean>
</beans>
4. Reference

Related Links

- Spring Web Services Site [http://www.springframework.org/spring-ws]
- JAXB Reference Implementation Project [http://jaxb.java.net/]

Project Setup

Follow the Project Checkout instructions for git, then go to the project (relative path below).

```
$ cd enterprise/simple-spring-web-services
```

General Setup Instructions

General instructions for checking out the project with Eclipse and building with Maven.

Example Project Setup

Project Information

- Spring Framework 3.2.x
- Spring Web Services 2.1.x
Embedded Spring Web Services

David Winterfeldt

2009

When running a standalone application, there might be a need to have it controlled by web services. This example shows how to configure an embedded Jetty instance to run your Spring Web Services and still allow the embedded Spring Web Services context reference the main application context as a parent.

This example will primarily focus on embedding the Web Services, but it's based on Simple Spring Web Services. Anything not covered here should be explained in the other example.

1. Spring Configuration

The Jetty configuration configures what would be considered the server context even though there isn't anything there except a Person bean to be shared with the web application context. The Spring Web Services web application is created by adding a Context to Jetty that has the MessageDispatcherServlet and the Spring configuration file spring-ws-embedded-context.xml in it.

Note

There isn't a need for a web.xml. The configuration is completely handled by configuring Jetty in Spring.

embedded-jetty-context.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xmlns:p="http://www.springframework.org/schema/p"
      xmlns:context="http://www.springframework.org/schema/context"
      xsi:schemaLocation="http://www.springframework.org/schema/beans
                          http://www.springframework.org/schema/beans/spring-beans.xsd
                          http://www.springframework.org/schema/context
                          http://www.springframework.org/schema/context/spring-context.xsd">

<!-- This bean will be available for injection in the child context that the Web Service is in. -->
  <bean class="org.springbyexample.person.schema.beans.Person"
        p:id="1" p:firstName="Joe" p:lastName="Smith" />

<!-- Manually start server after setting parent context. (init-method="start") -->
  <bean id="jettyServer" class="org.mortbay.jetty.Server"
       destroy-method="stop"
       property name="threadPool">
    <bean id="ThreadPool"
          class="org.mortbay.thread.concurrent.ThreadPool">
      <constructor-arg value="0" />
    </bean>
  </bean>
</beans>
```
Bean from the main application context that will be wired into the embedded Spring Web Services context.

Jetty Server bean. Note that it's init method is not configured since this will be done programatically so the parent context is available when the Web Services application starts.

This bean removes the need for having a web.xml by creating a web context for the Spring Web Services. The context path for the webapp is set on this bean.

The MessageDispatcherServlet is configured as a servlet for the webapp. This is the main servlet that handles Spring Web Services.

The Spring configuration file, spring-ws-embedded-context.xml, is configured for the
MessageDispatcherServlet as a servlet parameter. This overrides the servlet's default configuration file, which would be /WEB-INF/spring-ws-servlet.xml (/WEB-INF/${servlet.name}-servlet.xml).

This configures the MessageDispatcherServlet to handle any incoming request.

This configuration file is the same as any that would be used to configure a Spring Web Services web application. If this file wasn't explicitly specified in the MessageDispatcherServlet, the servlet would look for the default file /WEB-INF/spring-ws-servlet.xml (/WEB-INF/${servlet.name}-servlet.xml).

/src/main/resources/spring-ws-embedded-context.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xmlns:p="http://www.springframework.org/schema/p"
      xmlns:context="http://www.springframework.org/schema/context"
      xsi:schemaLocation="http://www.springframework.org/schema/beans
http://www.springframework.org/schema/beans/spring-beans.xsd
http://www.springframework.org/schema/context
http://www.springframework.org/schema/context/spring-context.xsd">
  <context:component-scan base-package="org.springbyexample.ws.embedded.service" />
  <bean id="person" class="org.springframework.ws.wsdl.wsdl11.DefaultWsdl11Definition"
        p:portTypeName="Person"
        p:locationUri="/personService/"
        p:requestSuffix="-request"
        p:responseSuffix="-response">
    <property name="schema">
      <bean class="org.springframework.xml.xsd.SimpleXsdSchema"
            p:xsd="classpath:/person.xsd" />
    </property>
  </bean>
  <bean class="org.springframework.ws.server.endpoint.mapping.PayloadRootAnnotationMethodEndpointMapping">
    <description>An endpoint mapping strategy that looks for @Endpoint and @PayloadRoot annotations.</description>
  </bean>
  <bean class="org.springframework.ws.server.endpoint.adapter.MarshallingMethodEndpointAdapter">
    <description>Enables the MessageDispatchServlet to invoke methods requiring OXM marshalling.</description>
    <constructor-arg ref="marshaller" />
  </bean>
  <bean id="marshaller" class="org.springframework.oxm.jaxb.Jaxb2Marshaller"
        p:contextPath="org.springbyexample.person.schema.beans" />
</beans>
```

2. Code Example

The code excerpt below is from EmbeddedPersonServiceClientTest, and is run before any of the tests are run to initialize Jetty. Even though this is a unit test, this would be the same code that would be used to start a standalone Spring application. It could contain an executor pool, db connection pool, timer processes, etc.

The main application context is initialized, and then the Jetty Server bean is retrieved from it. Then the ServletContext from the Spring Web Services webapp is retrieved. An intermediary web application context is
created between the main application context and the Spring Web Services context. The intermediary web context is then set as an attribute on the ServletContext under the constant WebApplicationContext.ROOT_WEB_APPLICATION_CONTEXT_ATTRIBUTE, which indicates it should be used as the parent context for the web application. Then the Jetty server is ready to be started.

```java
AbstractApplicationContext ctx =
    new
    ClassPathXmlApplicationContext("/org/springbyexample/ws/embedded/embedded-jetty-context.xml"); ❶
ctx.registerShutdownHook();
Server server = (Server) ctx.getBean("jettyServer"); ❷
ServletContext servletContext = null;
for (Handler handler : server.getHandlers()) {
    if (handler instanceof Context) {
        Context context = (Context) handler;
        servletContext = context.getServletContext(); ❸
    }
}
XmlWebApplicationContext wctx = new XmlWebApplicationContext(); ❹
wctx.setParent(ctx);
wctx.setConfigLocation("" );
wctx.setServletContext(servletContext);
wctx.refresh();
servletContext.setAttribute(WebApplicationContext.ROOT_WEB_APPLICATION_CONTEXT_ATTRIBUTE, wctx); ❺
servletContext.setAttribute(WebApplicationContext.ROOT_WEB_APPLICATION_CONTEXT_ATTRIBUTE, wctx); ❹
server.start(); ❻
```

**Example 1** EmbeddedPersonServiceClientTest

1. Create the main application context which has Jetty configured in it.
2. Retrieve the Jetty server bean.
3. Retrieve the ServletContext from the Spring Web Services webapp. The context path of the Context doesn't need to be checked because it's the only Context configured.
4. Create a web application context as an intermediary between the main application context and the webapp's context.
5. Set created web application context as the parent context of the web application by setting it on the ServletContext under the WebApplicationContext.ROOT_WEB_APPLICATION_CONTEXT_ATTRIBUTE constant.

### 3. Reference

#### Related Links

- Spring Web Services Site [http://www.springframework.org/spring-ws]
- JAXB Reference Implementation Project [http://jaxb.java.net/]
- Jetty [http://www.mortbay.org/jetty/]

---

Spring by Example Version 1.3

Spring by Example
Simple Spring Web Services

Project Setup

Follow the Project Checkout instructions for git, then go to the project (relative path below).

$ cd enterprise/simple-spring-web-services

General Setup Instructions

General instructions for checking out the project with Eclipse and building with Maven.

Example Project Setup

Project Information

• Spring Framework 3.2.x
• Spring Web Services 2.1.x
Simple Spring Integration

David Winterfeldt

2009

This example uses Spring Integration [http://www.springframework.org/spring-integration] to process a book order and appropriately route the message depending on if it's a pickup from the store or it should be delivered. Spring Integration [http://www.springframework.org/spring-integration] is an implementation of Enterprise Integration Patterns [http://eaipatterns.com/].

From the Order gateway, the BookOrder is sent to the 'processOrder' channel. An OrderRouter routes the order either to the 'pickup' or 'delivery' channels based on the order's OrderType annotation. If the order is a pickup, the 'pickup' channel is bridged to the 'store' channel which is configured to have the StoreEndpoint do the final processing for this part of the flow. If the order is a delivery, the DeliveryTransformer converts the BookOrder into an OnlineBookOrder that contains the delivery address. The address is just hard coded in the example, but could have looked up an address in a real application. The online order is sent to the 'post' channel, which is configured to have the PostEndpoint handle the end of this part of the flow.

Order Message Flow

```
  processOrder
   | OrderRouter
 /     \
pickup delivery
  |     |
store DeliveryTransformer
  |     |
   | post
```

1. Spring Configuration

This configuration uses a combination of XML and classes with annotations to configure the message flow. The annotation-config element enables annotation-based configuration for Spring Integration [http://www.springframework.org/spring-integration]. The context:component-scan loads the annotated part of the configuration. The gateway element creates the Order gateway, which is the beginning of the flow. Different channels are created, a bridge between two channels using the bridge element, and the outbound-channel-adapter is used to configure an endpoint for the 'store' and 'post' channels.

OrderTest-context.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<beans:beans xmlns="http://www.springframework.org/schema/integration"
             xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
             xmlns:beans="http://www.springframework.org/schema/beans"
             xmlns:context="http://www.springframework.org/schema/context">
```
2. Code Example

The gateway, or main entry point to the order flow, is the `Order` interface. It was defined in the Spring configuration and the `@Gateway` annotation indicates what channel any items passed to `process(BookOrder order)` will be sent to.

```java
public interface Order {
    /**
     * Process a book order.
     */
    @Gateway(requestChannel="processOrder")
    public void process(BookOrder order);
}
```
Example 1 Order

The OrderRouter indicates it is a message endpoint by using the @MessageEndpoint on the class. The @Router annotation on processOrder(BookOrder order) configures the incoming channel by setting the inputChannel attribute. The method should return a String that matches one of the configured channels. In this case the incoming channel is set to 'processOrder' and depending on the order type either 'delivery' or 'pickup' will be returned.

```java
@MessageEndpoint
public class OrderRouter {

    final Logger logger = LoggerFactory.getLogger(OrderRouter.class);

    /**
     * Process order. Routes based on whether or not the order is a delivery or pickup.
     */
    @Router(inputChannel="processOrder")
    public String processOrder(BookOrder order) {
        String result = null;
        logger.debug("In OrderRouter. title='{}' quantity={} orderType={}",
                new Object[] { order.getTitle(), order.getQuantity(), order.getOrderType() });

        switch (order.getOrderType()) {
            case DELIVERY:
                result = "delivery";
                break;
            case PICKUP:
                result = "pickup";
                break;
        }
        return result;
    }
}
```

Example 2 OrderRouter

The StoreEndpoint is the end of the store pickup flow. It just retrieves the message payload and logs it's output. In a real application the order could be electronically sent or printed at the appropriate store so the order could be prepared for pickup.

```java
@MessageEndpoint
public class StoreEndpoint {

    final Logger logger = LoggerFactory.getLogger(StoreEndpoint.class);

    /**
     * Process an order for a pickup from the store.
     */
    public void processMessage(Message<BookOrder> message) {
        BookOrder order = message.getPayload();
        logger.debug("In StoreEndpoint. title='{}' quantity={} orderType={}",
                new Object[] { order.getTitle(), order.getQuantity(), order.getOrderType() });
    }
}
```
Example 3 StoreEndpoint

The DeliveryTransformer indicates `processMessage(BookOrder order)` is a transformer by using the `@Transformer` annotation. It converts a BookOrder from the 'delivery' channel to an OnlineBookOrder which will be sent to the 'post' channel. The address for the online order is hard coded, but in a real application the transformer could look up an address.

```java
@MessageEndpoint
class DeliveryTransformer {  
    final Logger logger = LoggerFactory.getLogger(DeliveryTransformer.class);

    /**  
     * Transforms a <code>BookOrder</code> that is a delivery  
     * into a <code>OnlineBookOrder</code>.  
     */  
    @Transformer(inputChannel="delivery", outputChannel="post")  
    public OnlineBookOrder processMessage(BookOrder order) {  
        logger.debug("In DeliveryTransformer. title='{}' quantity={} orderType={}",  
                new Object[] { order.getTitle(),  
                               order.getQuantity(),  
                               order.getOrderType() });  
        return new OnlineBookOrder(order.getTitle(), order.getQuantity(),  
                                   order.getOrderType(),  
                                   "1060 West Addison Chicago, IL 60613");  
    }  
}
```

Example 4 DeliveryTransformer

The PostEndpoint is the end of the delivery flow. It just retrieves the message payload for the online order and logs it’s output. In a real application the order could be electronically sent or printed at the appropriate warehouse so the order could be prepared for shipping to the address added by the DeliveryTransformer.

Note

The Message was passed in as an example, but since only the message payload is being used it could have been passed in directly (ex: `processMessage(OnlineBookOrder order)`). Also, `@Header` could have been used to annotate a method parameter to extract a value from the message header.
@MessageEndpoint
public class PostEndpoint {
    final Logger logger = LoggerFactory.getLogger(PostEndpoint.class);

    /*
     * Process a delivery order for sending by mail.
     */
    public void processMessage(Message<OnlineBookOrder> message) {
        OnlineBookOrder order = message.getPayload();

        logger.debug("In PostEndpoint. title='{}' quantity={} orderType={} address='{}'",
                new Object[] { order.getTitle(),
                        order.getQuantity(),
                        order.getOrderType(),
                        order.getAddress() });
    }
}

Example 5 PostEndpoint

3. Reference

Related Links

- Spring Integration [http://www.springframework.org/spring-integration]
- Enterprise Integration Patterns [http://eaipatterns.com/]

Project Setup

Follow the Project Checkout instructions for git, then go to the project (relative path below).

$ cd enterprise/spring-integration

General Setup Instructions

General instructions for checking out the project with Eclipse and building with Maven.

Example Project Setup

Project Information

- Spring Framework 3.2.x
- Spring Integration 2.2.x
JMX is good way to expose parts of your application for monitoring and management. Spring also provides support for exposing JMX for remote management (JSR-160 [http://jcp.org/en/jsr/detail?id=160]) and creating a client to manage it. This example registers a Spring bean as a JMX MBean, exposes the JMX server over JMX Messaging Protocol (JMXMP), and creates a client to access it.

To connect to the example using a JMX Management tool, JConsole can be used and comes with the JDK installation. In the IDE a break point could be set in the unit test or Thread.sleep could be added to pause the application from shutting down. To activate local JMX access, the Java argument -Dcom.sun.management.jmxremote must be used when starting the test.

```
$ jconsole
```

1. Spring Configuration

The `context:component-scan` creates a Spring bean from the `ServerManagerImpl`. The `context:mbean-export` element will register any annotation beans as JMX MBeans.

The `serverConnector` bean will expose JMX for remote management over JMXMP.

The `clientConnector` creates a remote reference as an `MBeanServerConnection`. From this `MBeanInfo` can be retrieved for different JMX MBeans. But even more convenient is to create a proxy of the MBean using the `MBeanProxyFactoryBean`. This creates a remote proxy to the MBean specified by the `p:objectName` attribute, and uses the `p:proxyInterface` attribute to set what interface should be used for the proxy.

**JmxTest-context.xml**

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xmlns:p="http://www.springframework.org/schema/p"
      xmlns:context="http://www.springframework.org/schema/context"
      xsi:schemaLocation="http://www.springframework.org/schema/beans
                         http://www.springframework.org/schema/beans/spring-beans.xsd
                         http://www.springframework.org/schema/context
                         http://www.springframework.org/schema/context/spring-context.xsd">

<context:component-scan base-package="org.springbyexample.jmx" />  
<context:mbean-export/>

<!-- Expose JMX over JMXMP -->
<bean id="serverConnector" class="org.springframework.jmx.support.ConnectorServerFactoryBean" />

<!-- Client connector to JMX over JMXMP -->
<bean id="clientConnector" class="org.springframework.jmx.support.MBeanServerConnectionFactoryBean"
     p:serviceUrl="service:jmx:jmxmp://localhost:9875" />  
</beans>
```
2. Code Example

The ServerManagerImpl is registered as a Spring bean, and then exposed as a JMX MBean.

The @Component annotation indicates that this class is eligible to be a Spring bean when context:component-scan runs. The @ManagedResource annotation indicates that the bean can be exported as a JMX MBean. It's objectName attribute is optional, but can be used to specify a specific name for the MBean. In this case it will be exposed under the 'org.springframework.jmx' directory with the name 'ServerManager'. By default it would have been exposed under the directory 'org.springframework.jmx' and subdirectory 'serverManagerImpl' with the name 'ServerManagerImpl'.

The @ManagedAttribute can expose a getter or setter by annotating the method. A method that takes multiple values can be exposed using @ManagedOperation along with @ManagedOperationParameters and @ManagedOperationParameter to parameters the operation can take.

```java
@Component
@ManagedResource(objectName="org.springframework.jmx:name=ServerManager", description="Server manager.")
public class ServerManagerImpl implements ServerManager {
    final Logger logger = LoggerFactory.getLogger(ServerManagerImpl.class);

    private String serverName = "springServer";
    private boolean serverRunning = true;
    private int minPoolSize = 5;
    private int maxPoolSize = 10;

    /**
     * Gets server name.
     */
    @ManagedAttribute(description="The server name.")
    public String getServerName() {
        return serverName;
    }

    /**
     * Whether or not the server is running.
     */
    @ManagedAttribute(description="Server's running status.")
    public boolean isServerRunning() {
        return serverRunning;
    }

    /**
     * Sets whether or not the server is running.
     */
    @ManagedAttribute(description="Whether or not the server is running.",
                       currencyTimeLimit=20,
                       persistPolicy="OnUpdate")
```
public void setServerRunning(boolean serverRunning) {
    this.serverRunning = serverRunning;
}

/**
 * Change db connection pool size.
 * @param min Minimum pool size.
 * @param max Maximum pool size.
 * @return int Current pool size.
 */
@ManagedOperation(description="Change db connection pool size.")
@ManagedOperationParameters({
    @ManagedOperationParameter(name="min", description= "Minimum pool size.")
})
public int changeConnectionPoolSize(int minPoolSize, int maxPoolSize) {
    Assert.isTrue((minPoolSize > 0),
        "Minimum connection pool size must be larger than zero. min=" + minPoolSize);
    Assert.isTrue((minPoolSize < maxPoolSize),
        "Minimum connection pool size must be smaller than the maximum." +
        " min=" + minPoolSize + ", max=" + maxPoolSize);

    this.minPoolSize = minPoolSize;
    this.maxPoolSize = maxPoolSize;

    int diff = (maxPoolSize - minPoolSize);
    // randomly generate current pool size between new min and max
    Random rnd = new Random();
    int currentSize = (minPoolSize + rnd.nextInt(diff));

    logger.info("Changed connection pool size. min={}, max={}, current={}",
        new Object[]{this.minPoolSize, this.maxPoolSize, currentSize});

    return currentSize;
}

Example 1 ServerManagerImpl

@Autowired
private MBeanServerConnection clientConnector = null;

@Autowired
@Qualifier("serverManagerProxy")
private ServerManager serverManager = null;

public void testMBeanServerConnection() {
    MBeanInfo beanInfo = null;
    try {
        beanInfo = clientConnector.getMBeanInfo(new
            ObjectName("org.springbyexample.jmx:name=ServerManager"));
    } ...
}

public void testServerManagerRemoteProxy() {
    ...
    logger.info("serverName={}, serverRunning={}",
        serverManager.getServerName(), serverManager.isServerRunning());
```java
int min = 10;
int max = 20;
int result = serverManager.changeConnectionPoolSize(min, max);
...}
```

**Example 2 Excerpt from JmxTest**

### 3. Reference

#### Related Links

- Spring 3.2.x JMX Documentation [http://static.springsource.org/spring/docs/3.2.x/spring-framework-reference/html/jmx.html]
- Java Management Extensions (JMX) [http://www.oracle.com/technetwork/java/javase/tech/javamanagement-140525.html]
- Monitoring and Management Using JMX [http://docs.oracle.com/javase/1.5.0/docs/guide/management/agent.html]

#### Project Setup

Follow the Project Checkout instructions for git, then go to the project (relative path below).

```bash
$ cd enterprise/spring-jmx
```

#### General Setup Instructions

General instructions for checking out the project with Eclipse and building with Maven.

**Example Project Setup**

#### Project Information

- Spring Framework 3.2.x
Spring Modules JCR Node Creation & Retrieval

David Winterfeldt
2008

This example shows how to create and retrieve nodes and files (content nodes) using Spring Modules JCR (Java Content Repository (JSR-170)) module. This example uses Apache Jackrabbit for the Java Content Repository which is the reference implementation for JSR-170.

1. Spring Configuration

The first bean definition defines defines the Jackrabbit repository by specifying the configuration file to use and the location of the repository. If the repository doesn't already exist, it will be created on startup. The next bean creates a session factory based on the repository and the next one creates a JcrTemplate using the session factory.

JcrNodeCreationIT-context.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:p="http://www.springframework.org/schema/p"
    xmlns:context="http://www.springframework.org/schema/context"
    xsi:schemaLocation="http://www.springframework.org/schema/beans
    http://www.springframework.org/schema/beans/spring-beans.xsd
    http://www.springframework.org/schema/context
    http://www.springframework.org/schema/context/spring-context.xsd">
    <!-- Register Annotation-based Post Processing Beans -->
    <context:annotation-config />
    <!-- normal repository -->
    <bean id="repository"
        class="org.springmodules.jcr.jackrabbit.RepositoryFactoryBean"
        p:configuration="classpath:/jackrabbit-repository.xml"
        p:homeDir="file:./target/repo" />
    <bean id="sessionFactory"
        class="org.springmodules.jcr.jackrabbit.JackrabbitSessionFactory"
        p:repository-ref="repository" />
    <bean id="jcrTemplate"
        class="org.springmodules.jcr.JcrTemplate"
        p:sessionFactory-ref="sessionFactory"
        p:allowCreate="true" />
</beans>
```

2. Code Example
This code using `JcrTemplate` creates a node if one doesn't already exist in the repository.

```
private String nodeName = "fileFolder";
...

public void testAddNodeIfDoesntExist() {
    assertNotNull("JCR Template is null.", template);
    template.execute(new JcrCallback() {
        public Object doInJcr(Session session) throws RepositoryException {
            Node root = session.getRootNode();
            logger.debug("Starting from root node. node={}", root);
            Node node = null;
            if (root.hasNode(nodeName)) {
                node = root.getNode(nodeName);
                logger.debug("Node exists. node={}", node);
            } else {
                node = root.addNode(nodeName);
                session.save();
                logger.info("Saved node. node={}", node);
            }
            assertNotNull("Node is null.", node);
            return node;
        }
    });
}
```

**Example 1 Node Creation (Excerpt from JcrNodeCreationIT)**

This code using `JcrTemplate` creates a file node by attaching one if one doesn't already exist in the repository.

If the file node doesn't exist, it is created from the log4j.xml file in the classpath by passing in an `InputStream` of the file. After this you will see the part of the unit test that retrieves the file node and checks if the first and last line are correct.

The first thing that is done is to retrieve the root node from the JCR Session by calling `session.getRootNode()`. Then the expected folder node that should contain the file is located just under the root node, so `root.getNode(nodeName)` is called to retrieve the folder node. Then if the file node doesn't exist under the folder node, it's created. First a node named based on the file name is created under the folder node, then a JCR content node is created under the file node and a data property is where the actual file (as an `InputStream`) is set.

```
private String nodeName = "fileFolder";
...

public void testAddFileIfDoesntExist() {
    Node node = (Node) template.execute(new JcrCallback() {
        ```
public Object doInJcr(Session session) throws RepositoryException, IOException {
    Node resultNode = null;
    Node root = session.getRootNode();
    logger.info("starting from root node. node={}", root);
    // should have been created in previous test
    Node folderNode = root.getNode(nodeName);
    String fileName = "log4j.xml";
    if (folderNode.hasNode(fileName)) {
        logger.debug("File already exists. file={}", fileName);
    } else {
        InputStream in = this.getClass().getResourceAsStream("/", fileName);
        Node fileNode = folderNode.addNode(fileName, JcrConstants.NT_FILE);
        // create the mandatory child node - jcr:content
        resultNode = fileNode.addNode(JcrConstants.JCR_CONTENT, JcrConstants.NT_RESOURCE);
        resultNode.setProperty(JcrConstants.JCR_MIMETYPE, "text/xml");
        resultNode.setProperty(JcrConstants.JCR_ENCODING, "UTF-8");
        Calendar lastModified = Calendar.getInstance();
        lastModified.setTimeInMillis(System.currentTimeMillis());
        resultNode.setProperty(JcrConstants.JCR_LASTMODIFIED, lastModified);
        session.save();
        IOUtils.closeQuietly(in);
        logger.debug("Created '{}' file in folder.", fileName);
    }
    ...
}};

Example 2 File Node Creation (Excerpt from JcrNodeCreationIT)

This code using JcrTemplate to retrieve the content of a file node from the repository.

private String nodeName = "fileFolder";
...

public void testAddFileIfDoesntExist() {
    Node node = (Node) template.execute(new JcrCallback() {
        public Object doInJcr(Session session) throws RepositoryException, IOException {
            Node resultNode = null;
            JcrConstants jcrConstants = new JcrConstants(session);
            Node root = session.getRootNode();
            logger.info("starting from root node. node={}", root);
            // should have been created in previous test
            Node folderNode = root.getNode(nodeName);
            String fileName = "log4j.xml";

            // should have been created in previous test
            Node fileNode = folderNode.addNode(fileName, JcrConstants.NT_FILE);
            // create the mandatory child node - jcr:content
            resultNode = fileNode.addNode(JcrConstants.JCR_CONTENT, JcrConstants.NT_RESOURCE);
            resultNode.setProperty(JcrConstants.JCR_MIMETYPE, "text/xml");
            resultNode.setProperty(JcrConstants.JCR_ENCODING, "UTF-8");
            Calendar lastModified = Calendar.getInstance();
            lastModified.setTimeInMillis(System.currentTimeMillis());
            resultNode.setProperty(JcrConstants.JCR_LASTMODIFIED, lastModified);
            session.save();
            IOUtils.closeQuietly(in);
            logger.debug("Created '{}' file in folder.", fileName);
            ...
        }
    });
}
Example 3 File Node Retrieval (Excerpt from JcrNodeCreationIT)

3. Reference

Related Links

- Spring by Example JCR Site [http://springbyexample.org/maven/site/sbe-jcr/1.0.3/sbe-jcr/]
- Spring Modules [http://www.springsource.org/spring-modules]
- Apache Jackrabbit [http://jackrabbit.apache.org/]
- Integrating Java Content Repository and Spring [http://www.infoq.com/articles/spring-modules-jcr]

Project Setup

Follow the Project Checkout instructions for git, then go to the project (relative path below).

```
$ cd enterprise/spring-modules-jcr
```

General Setup Instructions

General instructions for checking out the project with Eclipse and building with Maven.

Example Project Setup

Project Information

- Spring Framework 3.2.x
Velocity E-mail Template

David Winterfeldt
2009

A Velocity template is used to generate the body of an e-mail and then is sent using Spring mail sender.

Note

When running the example, the `mailSender` bean in the Spring configuration needs to be edited to a valid host, and the `mail.properties` file also needs to have valid user and password for this host entered along with setting the test e-mail recipient.

1. Spring Configuration

The `context:component-scan` loads the `VelocityEmailSender` bean, and the `context:property-placeholder` loads the mail properties which have the mail user, password, and e-mail recipient.

The `velocityEngine` bean is created by Spring's `VelocityEngineFactoryBean`. It sets the `resourceLoaderPath` property to `classpath:/org/springbyexample/email`, so the Velocity engine will use this as the root of any template references. By setting `preferFileSystemAccess` property to 'false', a Spring resource loader will be used for loading template resources instead of the default Velocity file resource loader.

The `mailSender` bean is configured to send to Gmail. It can be customized to match another host and many will probably not need any extra Java Mail properties defined. The `templateMessage` bean at the end of the configuration is just used to pass in the from address, recipient address, and the subject to use when constructing `MimeMessageHelper` in the `VelocityEmailSender` (which is below in the Code Example).

VelocityEmailSenderIT-context.xml

```xml
<beans xmlns="http://www.springframework.org/schema/beans" 
xmllns:xsi="http://www.w3.org/2001/XMLSchema-instance" 
xmllns:p="http://www.springframework.org/schema/p" 
xmllns:context="http://www.springframework.org/schema/context" 
xmllns:util="http://www.springframework.org/schema/util" 
xsi:schemaLocation="http://www.springframework.org/schema/beans 
http://www.springframework.org/schema/beans/spring-beans.xsd 
http://www.springframework.org/schema/context 
http://www.springframework.org/schema/context/spring-context.xsd"> 
  <context:component-scan base-package="org.springbyexample.email" /> 
  <!-- Edit 'mail.properties' to set a valid user and password for the mail sender. --> 
  <context:property-placeholder location="classpath:/mail.properties" /> 
  <bean id="velocityEngine" class="org.springframework.ui.velocity.VelocityEngineFactoryBean" 
    p:resourceLoaderPath="classpath:/org/springbyexample/email" 
    p:preferFileSystemAccess="false"/> 
  <!-- Mail sender configured for using Gmail --> 
  <bean id="mailSender" class="org.springframework.mail.javamail.JavaMailSenderImpl" 
    p:host="smtp.gmail.com"/>
</beans>
```
2. Code Example

The `send(SimpleMailMessage, Map<Object, Object>)` method uses a `MimeMessagePreparator` to create an e-mail with an HTML body. The recipient address, from address, and subject are set on the message. Then Spring's `VelocityEngineUtils` is used to generate the message body. It uses the Velocity engine, the location of the template (which is in the '/org/springbyexample/email' package), and the variables for Velocity to use during template generation. After the mime message is created is is send using the `JavaMailSender`.

If a plain text body was being used the `MailSender` interface could be used to send a `SimpleMailMessage`.

```java
@Component
public class VelocityEmailSender implements Sender {
    private static final Logger logger = LoggerFactory.getLogger(VelocityEmailSender.class);
    private final VelocityEngine velocityEngine;
    private final JavaMailSender mailSender;

    /**
     * Constructor
     */
    @Autowired
    public VelocityEmailSender(VelocityEngine velocityEngine,
                                JavaMailSender mailSender) {
        this.velocityEngine = velocityEngine;
        this.mailSender = mailSender;
    }

    /**
     * Sends e-mail using Velocity template for the body and
     * the properties passed in as Velocity variables.
     *
     * @param msg The e-mail message to be sent, except for the body.
     * @param hTemplateVariables Variables to use when processing the template.
     */
    public void send(final SimpleMailMessage msg,
                     final Map<String, Object> hTemplateVariables) {
        MimeMessagePreparator preparator = new MimeMessagePreparator() {
            public void prepare(MimeMessage mimeMessage) throws Exception {
                MimeMessageHelper message = new MimeMessageHelper(mimeMessage);
                message.setTo(msg.getTo());
            }
        };
        preparator.prepare(mimeMessage); // prepare MIME message
        mailSender.send(mimeMessage); // send MIME message
    }
}
```
message.setFrom(msg.getFrom());
message.setSubject(msg.getSubject());

String body = VelocityEngineUtils.mergeTemplateIntoString(velocityEngine, "emailBody.vm", hTemplateVariables);
logger.info("body={}", body);
message.setText(body, true);
}
}

mailSender.send(preparator);
logger.info("Sent e-mail to '{}'.", msg.getTo());

Example 1 VelocityEmailSender

3. Reference

Related Links

• Spring 3.2.x E-mail Documentation [http://static.springsource.org/spring/docs/3.2.x/spring-framework-reference/html/mail.html]

• Spring 3.2.x E-mail Template Documentation [http://static.springsource.org/spring/docs/3.2.x/spring-framework-reference/html/mail.html#mail-templates-example]

• Velocity Engine [http://velocity.apache.org/engine/]

Project Setup

Follow the Project Checkout instructions for git, then go to the project (relative path below).

$ cd enterprise/velocity-email-template

General Setup Instructions

General instructions for checking out the project with Eclipse and building with Maven.

Example Project Setup

Test Setup

After updating the mailSender bean in the Spring configuration to have a valid host, and the 'mail.properties', run the command below to run the test from the command line. Because of manual configuration changes the test is
excluded from the other integration tests.

```
$ mvn -Pit -Dit.test=VelocityEmailSenderIT verify
```

**Project Information**

- Spring Framework 3.2.x

**Note**

The Solr [http://lucene.apache.org/solr/] server needs to be started before running the unit tests. After downloading Solr [http://lucene.apache.org/solr/] and changing to it's directory, the example server can be run and in another console window the sample data can be loaded into the server using the commands below.

```bash
$ cd example
$ java -jar start.jar
$ cd example/exampledocs
$ java -jar post.jar *.xml
```

1. Connecting to Solr using SolrOxmClient

**Spring Configuration**

The `context:component-scan` loads the CatalogItemMarshaller which marshalls an update request and unmarshalls a search request. The `context:property-placeholder` loads values for the Solr [http://lucene.apache.org/solr/] host and port. The `selectUrl` bean sets up the URL for a select, which is used by an HttpClientTemplate, but just for debugging the XML of the search result. The `solrOxmClient` bean just needs the base url for Solr [http://lucene.apache.org/solr/] and a marhsaller and unmarshaller.

```xml
<beans xmlns="http://www.springframework.org/schema/beans"
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xmlns:p="http://www.springframework.org/schema/p"
   xmlns:context="http://www.springframework.org/schema/context"
   xsi:schemaLocation="http://www.springframework.org/schema/beans
   http://www.springframework.org/schema/beans/spring-beans.xsd
   http://www.springframework.org/schema/context
   http://www.springframework.org/schema/context/spring-context.xsd">
  <!-- Loads CatalogItemMarshaller -->
  <context:component-scan base-package="org.springbyexample.enterprise.solr" />
</beans>
```
<context:property-placeholder location="org/springbyexample/enterprise/solr/solr.properties"/>

<bean id="selectUrl" class="java.lang.String">
    <constructor-arg value="http://${solr.host}:${solr.port}/solr/select" />
</bean>

<bean id="solrOxmClient" class="org.springbyexample.httpclient.solr.SolrOxmClient">
    <p:baseUrl="http://${solr.host}:${solr.port}/solr"/>
    <p:marshaller-ref="catalogItemMarshaller"/>
    <p:unmarshaller-ref="catalogItemMarshaller"/>
</bean>

</beans>

---

**Code Example**

The SolrOxmClient supports marshalling searches and unmarshalling updates. Updates and deletes autocommit, but their methods are overridden so a boolean can be passed in to control commits. It also allows for direct calls to commit, rollback, and optimize. Commit and optimize both support creating requests with max segments, wait flush, and wait searcher by using SolrRequestAttributes.

**Note**

The statistics for searches, updates, commits, etc. can be checked using Solr Stats [http://localhost:8983/solr/admin/stats.jsp].

**Search**

Simple search passing in a query. It could be any valid Solr [http://lucene.apache.org/solr/] query.

```java
List<CatalogItem> lCatalogItems = client.search(SEARCH_QUERY_PARAM);
```

*Example 1 Excerpt from SolrOxmClientIT.testSearch()*

**Paginated Search**

The 'start' & 'rows' indicate what range of the results to return in the Map. The search query is 'electronics' and is passed into the search along with the Map.

The 'indent' value isn’t used by the unmarshaller, and shouldn't be set since it will introduce whitespace in the XML results. In this case it is set so a debug request request that logs the unprocessed XML results is easier to read.

```java
Map<String, String> hParams = new HashMap<String, String>();
hParams.put("start", "5");
hParams.put("rows", "5");
hParams.put("indent", "on");
```
List<CatalogItem> lCatalogItems = client.search("electronics", hParams);

Example 2 Excerpt from SolrOxmClientIT.testPaginatedSearch()

Update

Adds or updates any records in the list based on their id. A commit request is sent immediately after the update.

List<CatalogItem> lCatalogItems = new ArrayList<CatalogItem>();
CatalogItem item = new CatalogItem();
  item.setId(CATALOG_ITEM_ID);
  item.setManufacturer(CATALOG_ITEM_MANUFACTURER);
  item.setName(CATALOG_ITEM_NAME);
  item.setPrice(CATALOG_ITEM_PRICE);
  item.setInStock(CATALOG_ITEM_IN_STOCK);
  item.setPopularity(expectedPopularity);
lCatalogItems.add(item);
client.update(lCatalogItems);

Example 3 Excerpt from SolrOxmClientIT.testUpdate()

Rollback

Update is called passing in the list and a boolean value of false indicating not to commit the update. Then commit or rollback can be called manually. In this example rollback is called.

List<CatalogItem> lCatalogItems = new ArrayList<CatalogItem>();
CatalogItem item = new CatalogItem();
  item.setId(CATALOG_ITEM_ID);
  item.setManufacturer(CATALOG_ITEM_MANUFACTURER);
  item.setName(CATALOG_ITEM_NAME);
  item.setPrice(CATALOG_ITEM_PRICE);
  item.setInStock(CATALOG_ITEM_IN_STOCK);
  item.setPopularity(popularity);
lCatalogItems.add(item);
// update without commit
client.update(lCatalogItems, false);
...
client.rollback();
Example 4 Excerpt from SolrOxmClientIT.testRollback()

Delete

This deletes by using a query matching all 'manu' fields with 'Belkin'. A commit is immediately sent after the delete request. There is also a deleteById(String) for deleting specific records based on their id.

```java
client.deleteByQuery("manu:Belkin");
```

Example 5 Excerpt from SolrOxmClientIT.testDelete()

Optimize

Sends a request to optimize the search engine.

```java
client.optimize();
```

Example 6 Excerpt from SolrOxmClientIT.testOptimize()

Creating a marshaller/unmarshaller is the most work setting up the SolrOxmClient since it handles the custom marshalling and unmarshalling between the custom JavaBean and the search fields configured in Solr [http://lucene.apache.org/solr/].

Implementation of Spring OXM Marshaller and Unmarshaller using dom4j [http://www.dom4j.org/].

```java
@Component
public class CatalogItemMarshaller implements Marshaller, Unmarshaller {

    final Logger logger = LoggerFactory.getLogger(CatalogItemMarshaller.class);

    private static final String ADD_ELEMENT_NAME = "add";
    private static final String DOC_ELEMENT_NAME = "doc";
    private static final String FIELD_ELEMENT_NAME = "field";
    private static final String FIELD_ELEMENT_NAME_ATTRIBUTE = "name";

    /**
     * Implementation of <code>Marshaller</code>.
     */
    @SuppressWarnings("unchecked")
    public void marshal(Object bean, Result result) throws XmlMappingException, IOException {
        List<CatalogItem> lCatalogItems = (List<CatalogItem>) bean;

        OutputStream out = null;
        XMLWriter writer = null;

        if (result instanceof StreamResult) {
            try {
                out = ((StreamResult) result).getOutputStream();
```
for (CatalogItem item : lCatalogItems) {
    Element doc = root.addElement(DOC_ELEMENT_NAME);
    doc.addElement(FIELD_ELEMENT_NAME).addAttribute(FIELD_ELEMENT_NAME_ATTRIBUTE, "id").addText(item.getId());
    doc.addElement(FIELD_ELEMENT_NAME).addAttribute(FIELD_ELEMENT_NAME_ATTRIBUTE, "manu").addText(item.getManufacturer());
    doc.addElement(FIELD_ELEMENT_NAME).addAttribute(FIELD_ELEMENT_NAME_ATTRIBUTE, "name").addText(item.getName());
    doc.addElement(FIELD_ELEMENT_NAME).addAttribute(FIELD_ELEMENT_NAME_ATTRIBUTE, "price").addText(new Float(item.getPrice()).toString());
    doc.addElement(FIELD_ELEMENT_NAME).addAttribute(FIELD_ELEMENT_NAME_ATTRIBUTE, "inStock").addText(BooleanUtils.toStringTrueFalse(item.isInStock()));
    doc.addElement(FIELD_ELEMENT_NAME).addAttribute(FIELD_ELEMENT_NAME_ATTRIBUTE, "popularity").addText(new Integer(item.getPopularity()).toString());
}
}

/**
 * Implementation of <code>Unmarshaller</code>
 */
@SuppressWarnings("unchecked")
public Object unmarshal(Source source) throws XmlMappingException, IOException {
    List<CatalogItem> lResults = new ArrayList<CatalogItem>);

    if (source instanceof StreamSource) {
        InputStream in = null;
        try {
            in = ((StreamSource) source).getInputStream();
            SAXReader reader = new SAXReader();
            Document document = reader.read(in);
            List<Node> lNodes = document.selectNodes("//response/result[@name='response']/doc/*");
            CatalogItem item = null;
            // loop over all matching nodes in order, so can create a new bean
            // instance on the first match and add it to the results on the last
            for (Node node : lNodes) {
                if (BooleanUtils.toBoolean(node.valueOf("./@name='id'"))) {
                    item = new CatalogItem();
                    item.setId(node.getText());
                } else if (BooleanUtils.toBoolean(node.valueOf("./@name='inStock'"))) {
                    item.setInStock(BooleanUtils.toBoolean(node.getText()));
                } else if (BooleanUtils.toBoolean(node.valueOf("./@name='manu'"))) {
                    item.setManufacturer(node.getText());
                }
            }
        }
    }
}

logger.debug("Marshalled bean of size {}.", lCatalogItems.size());
}
Example 7 CatalogItemMarshaller

2. Connecting to Solr using HttpClientTemplate & HttpClientOxmTemplate

Spring Configuration

An HttpClientTemplate and HttpClientOxmTemplate are configured. The former is used for non-marshalling requests and the latter is for marshallin requests.

SolrHttpClientTemplateIT-context.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xmlns:p="http://www.springframework.org/schema/p"
   xmlns:context="http://www.springframework.org/schema/context"
   xsi:schemaLocation="http://www.springframework.org/schema/beans
   http://www.springframework.org/schema/beans/spring-beans.xsd
   http://www.springframework.org/schema/context
   http://www.springframework.org/schema/context/spring-context.xsd">

   <!-- Loads CatalogItemMarshaller -->
</beans>
```

---

Spring by Example Version 1.3

Spring by Example
Code Example

A basic search, paginated search, and update will be shown using marshalling and unmarshalling with HttpClientOxmTemplate. Also HttpClientTemplate is used to make search requests and log the results for debugging.

Search

A simple search is made by passing in the search query as the key of 'q'. The selectTemplate is the HttpClientTemplate and performs a search based Map and logs the results. The same Map is then used by the marshallingSelectTemplate to make a request that is unmarshalled into a list of CatalogItem.

```java
public void testSearch() {
    assertNotNull("HttpClientOxmTemplate is null.", marshallingSelectTemplate);
    Map<String, String> hParams = new HashMap<String, String>();
    hParams.put("q", SEARCH_QUERY_PARAM);
    hParams.put("indent", "on");
    // just for debugging
    selectTemplate.executeGetMethod(hParams, new ResponseStringCallback() {  
        public void doWithResponse(String response) throws IOException {
            logger.debug(response);
        }
    });
    marshallingSelectTemplate.executeGetMethod(hParams,
        new ResponseCallback<List<CatalogItem>>() {
            public void doWithResponse(List<CatalogItem> lCatalogItems) throws IOException {
                assertNotNull("Catalog item list is null.", lCatalogItems);
            }
        });
}
```
Example 8 Excerpt from SolrHttpClientTemplateIT.testSearch()

**Paginated Search**

This search is paginated since it defines what range of results to return, which are defined by the 'start' key and the 'rows' key. The search parameter is defined by the 'q' key, and searches for any record that has 'electronics' in it. The 'indent' key is useful for having formatted results logged by `selectTemplate` for debugging.

```java
public void testPaginatedSearch() {
    assertNotNull("HttpClientOxmTemplate is null.", marshallingSelectTemplate);
    Map<String, String> hParams = new HashMap<String, String>();
    hParams.put("q", "electronics");
    hParams.put("start", "5");
    hParams.put("rows", "5");
    hParams.put("indent", "on");
    // just for debugging
    selectTemplate.executeGetMethod(hParams, new ResponseStringCallback() {
        public void doWithResponse(String response) throws IOException {
            logger.debug(response);
        }
    });
    marshallingSelectTemplate.executeGetMethod(hParams,
        new ResponseCallback<List<CatalogItem>>() {
            public void doWithResponse(List<CatalogItem> lCatalogItems) throws IOException {
                assertNotNull("Catalog item list is null.", lCatalogItems);
                int expectedCount = 5;
                assertEquals("Catalog item list should be '" + expectedCount + '".", expectedCount,
                    lCatalogItems.size());
                CatalogItem item = lCatalogItems.get(0);
                logger.debug("id={} manufacturer={} name={} price={} inStock={} popularity={}",
                    item.getId(), item.getManufacturer(), item.getName(),
                    item.getPrice(), item.isInStock(), item.getPopularity());
            }
        });
}
```
Example 9 Excerpt from SolrHttpClientTemplateIT.testPaginatedSearch()

Update

Adds or updates a list of JavaBeans and then calls commit. The add or update isn't committed until a commit is sent.

```java
public void testUpdate() {
...
    List<CatalogItem> lCatalogItems = new ArrayList<CatalogItem>();
    CatalogItem item = new CatalogItem();
    item.setId(CATALOG_ITEM_ID);
    item.setManufacturer(CATALOG_ITEM_MANUFACTURER);
    item.setName(CATALOG_ITEM_NAME);
    item.setPrice(CATALOG_ITEM_PRICE);
    item.setInStock(CATALOG_ITEM_IN_STOCK);
    item.setPopularity(expectedPopularity);
    lCatalogItems.add(item);
    marshallingUpdateTemplate.executePostMethod(lCatalogItems);
    // have to commit the updates
    updateTemplate.executePostMethod(COMMIT);
...
}
```

Example 10 Excerpt from SolrHttpClientTemplateIT.testUpdate()

3. Reference

Related Links

- Apache Solr [http://lucene.apache.org/solr/]
- Spring by Example Utils Module

Project Setup

Follow the Project Checkout instructions for git, then go to the project (relative path below).

```bash
$ cd enterprise/solr-client
```

General Setup Instructions

General instructions for checking out the project with Eclipse and building with Maven.
Example Project Setup

**Project Information**

- Spring Framework 3.2.x
- Spring by Example Utils 1.2.3
- Apache Solr 3.6.1
Part VI. Contact Application

The contact application has a DAO module, WS (Web Service) Beans module, Services module, REST Services module, Web Application module, and a shared test module.

The DAO module contains the schema, JPA entities, and uses Spring Data JPA [http://www.springsource.org/spring-data/jpa] repositories. It uses Spring Profiles to have either an HSQL or PostgreSQL JDBC connection.

The Services module is to contain any business logic. All of it's APIs use JAXB beans and Dozer [http://dozer.sourceforge.net/] is used to convert between this beans and the JPA entities. Security and transactions are configured in this layer.

The REST Services module contains the REST clients & controllers, as well as their Spring configurations. JSON and XML views are supported for requests. The Jackson JSON Processor [http://jackson.codehaus.org/] is used for JSON marshalling. It has the standard JSON media type and a custom one that also includes class information for more complex data models.

The contact webapp has a standard JSP UI, Sencha ExtJS [http://www.sencha.com/products/extjs/], and also a Sencha Touch [http://www.sencha.com/products/touch/] UI.

The DAO, Services, and REST Services all have an abstract test class for each module that each test extends. This way within each module, all tests have a shared context so Spring only has to load once. All of these tests use an in memory database and the REST Services have an embedded jetty server. REST Services tests can be run with clients using JSON or XML for marshalling.
This is the DAO module for the Contact Application and has a basic JPA configuration with inheritance. It uses Spring Data JPA [http://www.springsource.org/spring-data/jpa] for its repositories and to set audit information when persisting and entity. JPA optimistic locking has also been added. This module is based on Spring Data JPA.

1. Spring Configuration

The first Spring configuration file sets up the DataSource, what SQL scripts should be run at startup, and any property placeholder files that should be loaded.

META-INF/spring/db/dao-datasource-context.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xmlns:p="http://www.springframework.org/schema/p"
      xmlns:context="http://www.springframework.org/schema/context"
      xmlns:util="http://www.springframework.org/schema/util"
      xsi:schemaLocation="http://www.springframework.org/schema/beans
                        http://www.springframework.org/schema/beans/spring-beans-3.2.xsd
                        http://www.springframework.org/schema/context
                        http://www.springframework.org/schema/context/spring-context-3.2.xsd
                        http://www.springframework.org/schema/util
                        http://www.springframework.org/schema/util/spring-util-3.2.xsd">
  <bean id="dataSource"
        class="org.apache.commons.dbcp.BasicDataSource"
        destroy-method="close"
        p:driverClassName="${jdbc.driver.class}"
        p:url="${jdbc.url}"
        p:username="${jdbc.username}"
        p:password="${jdbc.password}"
        p:initialSize="${jdbc.initial.size}"
        p:minIdle="${jdbc.min.idle}"
        p:maxIdle="${jdbc.max.idle}"
        p:maxActive="${jdbc.max.active}"
        p:timeBetweenEvictionRunsMillis="${jdbc.time.between eviction}"
        p:validationQueryTimeout="${jdbc.validation.query.timeout}"
        p:validationQuery="${jdbc.validation.query}"
        p:testOnBorrow="true"
        p:validationQueryTimeout="${jdbc.validation.query.timeout}"
        p:validationQuery="${jdbc.validation.query}" />
  <beans profile="hsql">
    <context:property-placeholder
      location="classpath:/sql/hsql.properties,classpath*:META-INF/config/**/*.properties" />
    <util:list id="databaseScriptsList" value-type="org.springframework.core.io.Resource">
      <value>classpath:/sql/hsql/schema.sql</value>
      <value>classpath:/sql/hsql/security_schema.sql</value>
    </util:list>
  </beans>
  <beans profile="postgresql">
    <context:property-placeholder
      location="classpath:/sql/postgresql.properties,classpath*:META-INF/config/**/*.properties,file:contact-app*.properties" />
    <util:list id="databaseScriptsList" value-type="org.springframework.core.io.Resource"/>
  </beans>
</beans>
```
❶ HSQL DB Spring profile.

❷ Context property placeholder is configured to explicitly load the hsql.properties file and load all properties under META-INF/config.

❸ PostgreSQL DB Spring profile.

❹ Context property placeholder is configured to explicitly load the postgresql.properties file and load all properties under META-INF/config. It also will load any property files from where the application is started that start with ‘contact-app’ and end with ‘.properties’.

The second Spring configuration file configures Spring Data JPA [http://www.springsource.org/spring-data/jpa], and it’s entity auditing feature. It also configures transactions, the entity manager, and runs any SQL scripts added to the 'databaseScriptsList' bean. The persistence unit name for JPA is set using the properties files that were loaded in the Spring profiles in the previous Spring Configuration. There is a persistence unit configuration for HSQL DB and PostgreSQL in the persistence.xml.

META-INF/spring/db/dao-jpa-context.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:p="http://www.springframework.org/schema/p"
    xmlns:tx="http://www.springframework.org/schema/tx"
    xmlns:jpa="http://www.springframework.org/schema/data/jpa"
    xsi:schemaLocation="http://www.springframework.org/schema/beans
    http://www.springframework.org/schema/beans/spring-beans.xsd
    http://www.springframework.org/schema/tx
    http://www.springframework.org/schema/tx/spring-tx.xsd
    http://www.springframework.org/schema/data/jpa
    http://www.springframework.org/schema/data/jpa/spring-jpa.xsd">
  <jpa:repositories base-package="org.springbyexample.contact.orm.repository" />
  <!-- auditing -->
  <jpa:auditing auditor-aware-ref="auditorAware" />
  <bean id="auditorAware" class="org.springbyexample.contact.orm.entity.AuditorAwareImpl" />
  <tx:annotation-driven />
  <bean id="transactionManager" class="org.springframework.orm.jpa.JpaTransactionManager"
      p:entityManagerFactory-ref="entityManagerFactory"/>
  <bean id="entityManagerFactory" class="org.springframework.orm.jpa.LocalContainerEntityManagerFactoryBean"
      p:dataSource-ref="dataSource"
      p:persistenceUnitName="${jpa.persistence.unit.name}"
      depends-on="dataSourceInitializer">
    <property name="jpaVendorAdapter">
      <bean class="org.springframework.orm.jpa.vendor.HibernateJpaVendorAdapter"/>
    </property>
    <property name="jpaProperties">
      <props>
        <prop key="hibernate.show_sql">${jpa.show.sql}</prop>
        <prop key="hibernate.generate_statistics">false</prop>
        <prop key="hibernate.cache.use_second_level_cache">${jpa.cache.use_second_level_cache}</prop>
      </props>
    </property>
    <property name="jpaProperties">
      <props>
        <prop key="hibernate.show_sql">${jpa.show.sql}</prop>
        <prop key="hibernate.generate_statistics">false</prop>
        <prop key="hibernate.cache.use_second_level_cache">${jpa.cache.use_second_level_cache}</prop>
      </props>
    </property>
</beans>
```
The persistence unit name is set using a property placeholder, which loaded the appropriate name based on the Spring DB profiles.

2. JPA Configuration

Two `persistence-unit` elements are defined. One for HSSQL DB and another for PostgreSQL.

**META-INF/persistence.xml**

```xml
<?xml version="1.0" encoding="UTF-8"?>
<persistence xmlns="http://java.sun.com/xml/ns/persistence"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://java.sun.com/xml/ns/persistence
    http://java.sun.com/xml/ns/persistence/persistence_2_0.xsd"
    version="2.0">
    <persistence-unit name="hsql">
        <provider>org.hibernate.ejb.HibernatePersistence</provider>
        <properties>
            <property name="hibernate.dialect" value="org.hibernate.dialect.HSQLDialect" />
            <property name="hibernate.hbm2ddl.auto" value="validate" />
            <property name="hibernate.ejb.naming_strategy" value="org.hibernate.cfg.ImprovedNamingStrategy" />
            <property name="hibernate.cache.provider_class" value="org.hibernate.cache.EhCacheProvider" />
            <property name="jadira.usertype.autoRegisterUserTypes" value="true" />
            <property name="jadira.usertype.databaseZone" value="jvm" />
        </properties>
    </persistence-unit>
    <persistence-unit name="postgresql">
        <provider>org.hibernate.ejb.HibernatePersistence</provider>
        <properties>
            <property name="hibernate.dialect" value="org.springbyexample.orm.dialect.TableNameSequencePostgreSQLDialect" />
            <property name="hibernate.hbm2ddl.auto" value="validate" />
            <property name="hibernate.ejb.naming_strategy" value="org.hibernate.cfg.ImprovedNamingStrategy" />
            <property name="hibernate.max_fetch_depth" value="3" />
            <property name="jadira.usertype.autoRegisterUserTypes" value="true" />
        </properties>
    </persistence-unit>
</persistence>
```
Register Joda DateTime support.

3. JPA Configuration

These are the two DB specific properties files that are loaded by their respective Spring profiles in `dao-datasource-context.xml`.

**sql hsq1.properties**

```properties
jdbc.driver.class=org.hsqldb.jdbcDriver
jdbc.url=jdbc:hsqldb:mem:contact
jdbc.username=sa
jdbc.password=
jdbc.initial.size=1
jdbc.min.idle=1
jdbc.max.idle=2
jdbc.max.active=4
jdbc.time.between.eviction=30000
jdbc.min.evictable.idle=60000
jdbc.validation.query.timeout=30000
jdbc.validation.query=select 1 from INFORMATION_SCHEMA.SYSTEM_USERS
jpa.persistence.unit.name=hsq1
jpa.show.sql=false
jpa.cache.use_second_level_cache=false
```

It is expected that the database is already initialized before running the application. In the contact-app project there is a scripts directory that contains `init-postgres.sh` and `reinit-postgres.sh`. The first script will just create the DB, user, and schema. The second will drop the DB and user first, before creating everything.

**Note**

DB Connection Pool min/max/idle/timeouts should be tuned for each application based on load testing.

**sql/postgresql.properties**

```properties
jdbc.driver.class=org.postgresql.Driver
jdbc.url=jdbc:postgresql://localhost:5432/contact
jdbc.username=contact
jdbc.password=contact
jdbc.initial.size=5
```
jdbc.min.idle=5  
jdbc.max.idle=10  
jdbc.max.active=20  
jdbc.time.between.eviction=30000  
jdbc.min.evictable.idle=60000  
jdbc.validation.query.timeout=30000  
jdbc.validation.query=select version()  

jpa.persistence.unit.name=postgresql  
jpa.show.sql=false  
jpa.cache.use_second_level_cache=true

This can be set to true by passing it in as a Java system property or by setting it in a contact-app.properties file.

4. Reference

Related Links

- Spring 3.2.x JPA Documentation  
  [http://static.springsource.org/spring/docs/3.2.x/spring-framework-reference/html/orm.html#orm-jpa]
- Hibernate [http://www.hibernate.org/]
- Apache Commons DBCP [http://commons.apache.org/dbcp]
- PostgreSQL [http://www.postgresql.org/]
- Spring Data JPA

Project Setup

Follow the Project Checkout instructions for git, then go to the project (relative path below).

```
cd app/contact-app/contact-dao
```

General Setup Instructions

General instructions for checking out the project with Eclipse and building with Maven.

Example Project Setup

Project Information

- Spring Framework 3.2.x
• Java Persistence API 2.0
Contact Application Web Service Beans

David Winterfeldt
2012

The WS (Web Service) Beans are used as the main model in the project, in and above the service layer. They are JAXB beans generated from XSDs. Besides always having a valid XSD to go with the XML generated, the generated Java classes have a fluent API for setting values (ex: `new Person.withId(1).withFirstName("John")`). They provide a way to decouple business logic and user facing APIs from a persistent store, multiple persistent stores, or 3rd party services.

1. Spring Configuration

The Spring OXM JAXB marshaller is defined, along with the packages it should manage.

META-INF/spring/marshaller/jaxb2-marshaller-context.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:p="http://www.springframework.org/schema/p"
    xmlns:context="http://www.springframework.org/schema/context"
    xsi:schemaLocation="http://www.springframework.org/schema/beans
    http://www.springframework.org/schema/beans/spring-beans.xsd
    http://www.springframework.org/schema/context
    http://www.springframework.org/schema/context/spring-context.xsd">
    <bean id="marshaller" class="org.springframework.oxm.jaxb.Jaxb2Marshaller">
        <property name="contextPaths">
            <array>
                <value>org.springbyexample.schema.beans.entity</value>
                <value>org.springbyexample.schema.beans.person</value>
                <value>org.springbyexample.schema.beans.response</value>
            </array>
        </property>
    </bean>
</beans>
```

2. JAXB Configuration

Custom JAXB bindings for date and date time to use Jode DateTime.

jaxb-bindings.xjb
Entity base model for persistent entities. It is defined as an `xsd:complexType` so it can be extended, but is annotated to have `XmlRootElement` so it can be serialized by JAXB if it is returned directly from a controller (as opposed to being part of another instance returned).

*entity-base.xsd*

Responses for single and multiple results. Abstract base classes are defined to provide a way to handle responses.
more generically in the Java code.

Excerpt from *response-base.xsd*

```xml
<xsd:schema xmlns="http://www.springbyexample.org/schema/beans/response"
    targetNamespace="http://www.springbyexample.org/schema/beans/response"
    xmlns:xsd="http://www.w3.org/2001/XMLSchema"
    xmlns:jaxb="http://java.sun.com/xml/ns/jaxb"
    xmlns:annox="http://annox.dev.java.net"
    jaxb:extensionBindingPrefixes="annox"
    jaxb:version="2.1">
    ...
    <xsd:complexType name="abstract-response">
        <xsd:annotation>
            <xsd:appinfo>
                <jaxb:class ref="org.springbyexample.schema.beans.response.AbstractResponse"/>
            </xsd:appinfo>
        </xsd:annotation>
    </xsd:complexType>
    <xsd:complexType name="abstract-response-result">
        <xsd:annotation>
            <xsd:appinfo>
            </xsd:appinfo>
        </xsd:annotation>
    </xsd:complexType>
    <xsd:complexType name="abstract-entity-response-result" abstract="true">
        <xsd:complexContent>
            <xsd:extension base="abstract-response-result">
                <xsd:sequence>
                    <xsd:element name="errors" type="xsd:boolean" />
                    <xsd:element name="message-list" type="message" minOccurs="0" maxOccurs="unbounded" />
                </xsd:sequence>
            </xsd:extension>
        </xsd:complexContent>
    </xsd:complexType>
    <xsd:complexType name="abstract-find-response-result">
        <xsd:annotation>
            <xsd:appinfo>
                <jaxb:class ref="org.springbyexample.schema.beans.response.AbstractFindResponseResult"/>
            </xsd:appinfo>
        </xsd:annotation>
    </xsd:complexType>
    <xsd:complexType name="abstract-entity-find-response-result" abstract="true">
        <xsd:complexContent>
            <xsd:extension base="abstract-find-response-result">
                <xsd:sequence>
                    <xsd:element name="errors" type="xsd:boolean" />
                    <xsd:element name="message-list" type="message" minOccurs="0" maxOccurs="unbounded" />
                </xsd:sequence>
            </xsd:extension>
        </xsd:complexContent>
    </xsd:complexType>
    <xsd:complexType name="response-result">
        <xsd:annotation>
            <xsd:appinfo>
            </xsd:appinfo>
        </xsd:annotation>
    </xsd:complexType>
</xsd:schema>
```
Person/Student/Professional complex types and their responses are defined.

**person-base.xsd**

```xml
<xsd:schema xmlns="http://www.springbyexample.org/schema/beans/person"
    targetNamespace="http://www.springbyexample.org/schema/beans/person"
    xmlns:xs="http://www.w3.org/2001/XMLSchema"
    xmlns:jaxb="http://java.sun.com/xml/ns/jaxb"
    xmlns:annox="http://annox.dev.java.net"
    jaxb:extensionBindingPrefixes="annox"
    xmlns:entity="http://www.springbyexample.org/schema/beans/entity"
    xmlns:response="http://www.springbyexample.org/schema/beans/response">

    <xsd:import namespace="http://www.springbyexample.org/schema/beans/entity"
        schemaLocation="entity-base.xsd" />

    <xsd:import namespace="http://www.springbyexample.org/schema/beans/response"
        schemaLocation="response-base.xsd" />

    <xsd:schema>

```
<xs:schema schemaLocation="response-base.xsd" />

  <xs:element name="person-response">
    <xs:complexType>
      <xs:complexContent>
        <xs:extension base="response:abstract-entity-response-result">
          <xs:sequence>
            <xs:element name="results" type="person" />
          </xs:sequence>
        </xs:extension>
      </xs:complexContent>
    </xs:complexType>
  </xs:element>

  <xs:element name="person-find-response">
    <xs:complexType>
      <xs:complexContent>
        <xs:extension base="response:abstract-entity-find-response-result">
          <xs:sequence>
            <xs:element name="results" type="person" minOccurs="0" maxOccurs="unbounded" />  
          </xs:sequence>
        </xs:extension>
      </xs:complexContent>
    </xs:complexType>
  </xs:element>

  <xs:element name="professional-response">
    <xs:complexType>
      <xs:complexContent>
        <xs:extension base="response:abstract-entity-response-result">
          <xs:sequence>
            <xs:element name="results" type="professional" />
          </xs:sequence>
        </xs:extension>
      </xs:complexContent>
    </xs:complexType>
  </xs:element>

  <xs:element name="professional-find-response">
    <xs:complexType>
      <xs:complexContent>
        <xs:extension base="response:abstract-entity-find-response-result">
          <xs:sequence>
            <xs:element name="results" type="professional" minOccurs="0" maxOccurs="unbounded" />  
          </xs:sequence>
        </xs:extension>
      </xs:complexContent>
    </xs:complexType>
  </xs:element>

  <xs:complexType name="person">
    <xs:annotation>
      <xs:appinfo>
        <annox:annotate annox:class="javax.xml.bind.annotation.XmlRootElement" name="person"/>
      </xs:appinfo>
    </xs:annotation>
    <xs:complexContent>
      <xs:extension base="entity:pk-entity-base">
        <xs:sequence>
          <xs:element name="first-name" type="xsd:string" />
          <xs:element name="last-name" type="xsd:string" />
        </xs:sequence>
      </xs:extension>
    </xs:complexContent>
  </xs:complexType>

  <xs:complexType name="student">
    <xs:annotation>
      <xs:appinfo>
        <annox:annotate annox:class="javax.xml.bind.annotation.XmlRootElement" name="person"/>
      </xs:appinfo>
    </xs:annotation>
    <xs:complexContent>
      <xs:extension base="entity:pk-entity-base">
        <xs:sequence>
          <xs:element name="first-name" type="xsd:string" />
        </xs:sequence>
      </xs:extension>
    </xs:complexContent>
  </xs:complexType>
3. Reference

Related Links

- JAXB Reference Implementation Project [http://jaxb.java.net/]

Project Setup

Follow the Project Checkout instructions for git, then go to the project (relative path below).

```
$ cd app/contact-app/contact-ws-beans
```

General Setup Instructions

General instructions for checking out the project with Eclipse and building with Maven.

Example Project Setup
Project Information

• Spring Framework 3.2.x
Contact Application Services

David Winterfeldt

2012

The service layer is a where business logic is located, and the persistent layer is converted to and from the JPA entities & JAXB beans using Dozer [http://dozer.sourceforge.net/].

This example doesn't have this, but the service layer is where general handling of exceptions and validation can be put in place using AOP. This way standard Spring runtime exceptions can be thrown, but before they would go to the REST controller layer they could be translated into i18n friendly user messages. Also validation can intercept requests and immediately return results before any of the actual business logic starts processing in a service.

1. Spring Configuration

This is the Spring Dozer Mapper configuration. More than one mapping file can be passed in or wild cards can be used to load mapper configs.

A larger application may have a need to have different dozer mappers with different rules, and they could all be defined here. Then Spring injection could be controlled with custom qualifiers. An example could be if you wanted to completely copy an existing contact, but exclude primary keys from being copied. Then this new copy could be persisted as a new record.

META-INF/spring/services/mapper-context.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xmlns:p="http://www.springframework.org/schema/p"
   xmlns:context="http://www.springframework.org/schema/context"
   xsi:schemaLocation="http://www.springframework.org/schema/beans
   http://www.springframework.org/schema/beans/spring-beans.xsd
   http://www.springframework.org/schema/context
   http://www.springframework.org/schema/context/spring-context.xsd">
  <bean id="org.dozer.Mapper" class="org.dozer.spring.DozerBeanMapperFactoryBean">
    <property name="mappingFiles">
      <list>
        <value>classpath:/dozer/dozer-joda-mappings.xml</value>
        <value>classpath:/dozer/dozer-mappings.xml</value>
      </list>
    </property>
  </bean>
</beans>
```

Spring configuration for loading all converters and services.

META-INF/spring/services/services-context.xml
Spring configuration for security. This has the authentication manager use the default JDBC user service and activates detection of the @Secured annotation on Spring beans.

**META-INF/spring/security/security-context.xml**

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xmlns:security="http://www.springframework.org/schema/security"
      xsi:schemaLocation="http://www.springframework.org/schema/beans
http://www.springframework.org/schema/beans/spring-beans.xsd
http://www.springframework.org/schema/security
http://www.springframework.org/schema/security/spring-security-3.1.xsd">
  <security:global-method-security secured-annotations="enabled" />
  <security:authentication-manager>
    <security:authentication-provider>
      <security:jdbc-user-service data-source-ref="dataSource" />
    </security:authentication-provider>
  </security:authentication-manager>
</beans>
```

2. Dozer Configuration

Custom mappings between classes and fields can be defined here, including referencing Spring custom converters can be defined in the placeholder config `dozer-mappings.xml`. Currently there is just a custom converter for Joda DateTime registered in `dozer-joda-mappings.xml`.

`dozer/dozer-joda-mappings.xml` in Spring by Example REST Module
3. Converter Code

There are two simple interfaces, `Converter` and `ListConverter`, used to copy to and from two different types classes. This provides a clear interface for the application to interact with even though Dozer [http://dozer.sourceforge.net/] is the primary implementation, it provides some flexibility for other possible implementations. Such as converting a JSON `String` to and from a class.

Simple interface for converting to and from any two classes.

```java
public interface Converter<T, V> {
    /**
     * Converts from a domain model to the business model.
     */
    public V convertTo(T source);

    /**
     * Converts from a business model to the domain model.
     */
    public T convertFrom(V source);
}
```

**Example 1 Converter in Spring by Example REST Module**

Simple interface for converting to and from lists of any two classes.

```java
public interface ListConverter<T, V> extends Converter<T, V> {
    /**
     * Converts from a domain model list to a business model list.
     */
    public List<V> convertListTo(Collection<T> list);
}
```
/**
 * Converts from a business model list to a domain model list.
 */
public List<T> convertListFrom(Collection<V> list);
}

Example 2 ListConverter in Spring by Example REST Module

Most converter implementations should just need to extend this class and pass in the appropriate parameters to the constructor.

public abstract class AbstractMapperListConverter<T, V> extends AbstractListConverter<T, V> {
    private final Mapper mapper;
    private final Class<T> tClazz;
    private final Class<V> vClazz;

    public AbstractMapperListConverter(Mapper mapper,
            Class<T> tClazz, Class<V> vClazz) {
        this.mapper = mapper;
        this.tClazz = tClazz;
        this.vClazz = vClazz;
    }

    @Override
    public V convertTo(T source) {
        Assert.notNull(source, "Source must not be null.");
        return mapper.map(source, vClazz);
    }

    @Override
    public T convertFrom(V source) {
        Assert.notNull(source, "Source must not be null.");
        return mapper.map(source, tClazz);
    }
}

Example 3 AbstractMapperListConverter in Spring by Example REST Module

The ContactConverter converts to and from the entity and JAXB bean. It extends AbstractMapperListConverter, which basically just delegates to Dozer.

@Component
public class ContactConverter extends AbstractMapperListConverter<org.springbyexample.contact.orm.entity.person.Person, Person> {
    @Autowired
    public ContactConverter(Mapper mapper) {
        super(mapper,
                org.springbyexample.contact.orm.entity.person.Person.class, Person.class);
    }
}
4. Persistence Service Code

Persistence Service Interface Code

There is a persistence interface and abstract base broken into read-only and persistent operations. For standard persistence based on Spring Data JPA [http://www.springsource.org/spring-data/jpa] repositories, just extending one of the base classes will handle basic persistence.

The find service takes a generic response and find response. The generic response is a wrapper, with messages, for a single result. The find response is for a standard and paginated search. It also can have messages.

```java
public interface PersistenceFindService<R extends EntityResponseResult, FR extends EntityFindResponseResult> {
    /**
     * Find a record with an id.
     */
    public R findById(Integer id);
    /**
     * Find all records.
     */
    public FR find();
    /**
     * Find a paginated record set.
     */
    public FR find(int page, int pageSize);
}
```

Besides a generic response and find response, the PersistenceService also takes the entity bean the persistence class handles.

```java
public interface PersistenceService<V extends PkEntityBase,
    R extends EntityResponseResult, FR extends EntityFindResponseResult>
    extends PersistenceFindService<R, FR> {
    /**
     * Creates a record.
     */
    public R create(V request);
    /**
     * Updates a record.
     */
    public R update(V request);
}
```
Persistence Service Abstract Code

The abstract persistence find service adds another generic value representing a Spring Data JPA [http://www.springsource.org/spring-data/jpa] entity. It expects a JpaRepository, Converter, and a MessageHelper for it's constructor. The MessageHelper is just a helper bean for accessing the Spring MessageSource.

The @Transactional annotation is set on the class to be read-only. Any method will automatically have a read-only transaction in any subclass unless marked otherwise. The converter is used to convert the Spring Data JPA [http://www.springsource.org/spring-data/jpa] results into ws beans, then an abstract method is used to create the response.

```java
@Transactional(readOnly=true)
public abstract class AbstractPersistenceFindService<T extends AbstractPersistable<Integer>, V extends PkEntityBase,
    R extends EntityResponseResult, FR extends EntityFindResponseResult>
    extends AbstractService implements PersistenceFindService<R, FR> {
    protected final JpaRepository<T, Integer> repository;
    protected final ListConverter<T, V> converter;
    public AbstractPersistenceFindService(JpaRepository<T, Integer> repository, ListConverter<T, V> converter,
        MessageHelper messageHelper) {
        super(messageHelper);
        this.repository = repository;
        this.converter = converter;
    }
    @Override
    public R findById(Integer id) {
        T bean = repository.findOne(id);
        V result = (bean != null ? converter.convertTo(bean) : null);
        return createResponse(result);
    }
    @Override
    public FR find() {
        List<V> results = converter.convertListTo(repository.findAll(createDefaultSort()));
        return createFindResponse(results);
    }
}
```
@Override
public FR find(int page, int pageSize) {
    Page<T> pageResults = repository.findAll(new PageRequest(page, pageSize,
        createDefaultSort()));

    List<V> results = converter.convertListTo(pageResults.getContent());
    return createFindResponse(results, pageResults.getTotalElements());
}
/**
 * Create a response.
 */
protected abstract R createResponse(V result);
/**
 * Create a find response with the count representing the size of the list.
 */
protected abstract FR createFindResponse(List<V> results);
/**
 * Create a find response with the results representing the page request
 * and the count representing the size of the query.
 */
protected abstract FR createFindResponse(List<V> results, long count);
/**
 * Whether or not the primary key is valid (greater than zero).
 */
protected boolean isPrimaryKeyValid(V request) {
    return DBUtil.isPrimaryKeyValid(request);
}
/**
 * Creates default sort.
 */
private Sort createDefaultSort() {
    return new Sort("lastName", "firstName");
}
}

Example 7 AbstractPersistenceFindService in Spring by Example REST Module

The AbstractPersistenceService extends AbstractPersistenceFindService and adds the methods create/update/delete. The create & update methods are separated they can have different Spring Security [http://static.springsource.org/spring-security/site/] annotations applied to a service interface, even though they both call into the same method for actually saving (doSave).

The create/update/delete methods also all are marked with @Transactional to override the default transactional configuration since they are not read-only transactions.
converter, MessageHelper messageHelper) {
    super(repository, converter, messageHelper);
}

@Override
@Transactional
public R create(V request) {
    Assert.isTrue(!isPrimaryKeyValid(request), "Create should not have a valid primary key.");
    return doSave(request);
}

@Override
@Transactional
public final R update(V request) {
    Assert.isTrue(isPrimaryKeyValid(request), "Update should have a valid primary key.");
    return doSave(request);
}

@Override
@Transactional
public R delete(V request) {
    return doDelete(request);
}

/**
 * Processes save. Can be overridden for custom save logic.
 */
protected R doSave(V request) {
    V result = null;
    T convertedRequest = converter.convertFrom(request);
    // issues with lock version updating if flush isn't called
    T bean = repository.saveAndFlush(convertedRequest);
    result = converter.convertTo(bean);
    return createSaveResponse(result);
}

/**
 * Processes delete. Can be overridden for custom save logic.
 */
protected R doDelete(V request) {
    repository.delete(request.getId());
    repository.flush();
    return createDeleteResponse();
}

/**
 * Create a save response.
 */
protected abstract R createSaveResponse(V result);

/**
 * Create a delete response.
 */
protected abstract R createDeleteResponse();

Example 8 AbstractPersistenceService in Spring by Example REST Module
5. Contact Service Code Example

The ContactService could just extend the PersistenceService, but instead it overrides each method so every service can set its own security rules. Without making any assumptions that they would all be consistent. If the application is known to have consistent security rules, they could be applied to the parent persistent interfaces and it wouldn't be necessary to apply them to each level.

```java
public interface ContactService extends PersistenceService<Person, PersonResponse, PersonFindResponse> {

  @Override
  @Secured ({ USER })
  public PersonResponse findById(Integer id);

  /**
   * Find by last name.
   */
  @Secured ({ USER })
  public PersonFindResponse findByLastName(String lastName);

  @Override
  @Secured ({ USER })
  public PersonFindResponse find();

  @Override
  @Secured ({ USER })
  public PersonFindResponse find(int page, int pageSize);

  @Override
  @Secured ({ USER })
  public PersonResponse create(Person person);

  @Override
  @Secured ({ USER })
  public PersonResponse update(Person person);

  @Override
  @Secured ({ ADMIN })
  public PersonResponse delete(Person person);
}
```

Example 9 ContactService

The ContactServiceImpl is the implementation for the ContactService. It shows that if you needed to override the default behavior for save, the doSave method can be overridden. If the service wasn't also trying to handle saves/conversions for subclasses this wouldn't be necessary. Otherwise just the abstract methods for creating responses is needed.

```java
@Service
public class ContactServiceImpl extends AbstractPersistenceService<
  org.springbyexample.contact.orm.entity.person.Person,
  Person, PersonResponse,
  PersonFindResponse>
  implements ContactService {

  private static final String SAVE_MSG = "contact.save.msg";
```
private final StudentConverter studentConverter;
private final ProfessionalConverter professionalConverter;

@Autowired
public ContactServiceImpl(PersonRepository repository,
            ContactConverter converter,
            StudentConverter studentConverter, ProfessionalConverter
            professionalConverter,
            MessageHelper messageHelper) {
    super(repository, converter, messageHelper);
    this.studentConverter = studentConverter;
    this.professionalConverter = professionalConverter;
}

@Override
protected PersonResponse doSave(Person request) {
    org.springframework.orm.entity.Person bean = null;
    if (request instanceof Student) {
        bean = studentConverter.convertFrom((Student) request);
    } else if (request instanceof Professional) {
        bean = professionalConverter.convertFrom((Professional) request);
    } else {
        bean = converter.convertFrom(request);
    }

    Person result = converter.convertTo(repository.saveAndFlush(bean));
    return createSaveResponse(result);
}

@Override
public PersonFindResponse findByLastName(String lastName) {
    List<Person> results =
            converter.convertListTo(((PersonRepository)repository).findByLastName(lastName));
    return createFindResponse(results);
}

@Override
protected PersonResponse createSaveResponse(Person result) {
    return new PersonResponse().withMessageList(new Message().withMessageType(MessageType.INFO)
            .withMessage(getMessage(SAVE_MSG, new Object[] { result.getFirstName(),
            result.getLastName()}))).withResults(result);
}

@Override
protected PersonResponse createDeleteResponse() {
    return new PersonResponse().withMessageList(new Message().withMessageType(MessageType.INFO)
            .withMessageKey(DELETE_MSG).withMessage(getMessage(DELETE_MSG)));
}

@Override
protected PersonResponse createResponse(Person result) {
    return new PersonResponse().withResults(result);
}

@Override
protected PersonFindResponse createFindResponse(List<Person> results) {
    return new PersonFindResponse().withResults(results).withCount(results.size());
}

@Override
protected PersonFindResponse createFindResponse(List<Person> results, long count) {
    return new PersonFindResponse().withResults(results).withCount(count);
}
Example 10 ContactServiceImpl

6. Reference

Related Links

- Contact Application Web Service Beans
- Contact Application DAO
- Dozer [http://dozer.sourceforge.net/]
- Spring Security [http://static.springsource.org/spring-security/site/]

Project Setup

Follow the Project Checkout instructions for git, then go to the project (relative path below).

```
$ cd app/contact-app/contact-services
```

General Setup Instructions

General instructions for checking out the project with Eclipse and building with Maven.

Example Project Setup

Project Information

- Spring Framework 3.2.x
Contact Application REST Services

David Winterfeldt

2012

REST services contains the Spring MVC Controllers and also the REST templates (clients) to access them. The clients are used in the unit tests. Also a client artifact is generated for other modules & external applications to use.

1. Spring Configuration

Spring MVC Configuration

The REST Controllers are loaded by context:component-scan, and a handler is created for them.

META-INF/spring/mvc/mvc-rest-context.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
       xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
       xmlns:p="http://www.springframework.org/schema/p"
       xmlns:context="http://www.springframework.org/schema/context"
       xsi:schemaLocation="http://www.springframework.org/schema/beans
                           http://www.springframework.org/schema/beans/spring-beans.xsd
                           http://www.springframework.org/schema/context
                           http://www.springframework.org/schema/context/spring-context.xsd">
  <context:component-scan base-package="org.springbyexample.contact.web.service"/>
  <bean class="org.springframework.web.servlet.mvc.method.annotation.RequestMappingHandlerMapping"/>
</beans>
```

Spring JSON Configuration

The Jackson JSON-processor [http://jackson.codehaus.org/] mapping and view are setup.

META-INF/spring/mvc/rest-json-converter-context.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
       xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
       xmlns:p="http://www.springframework.org/schema/p"
       xmlns:context="http://www.springframework.org/schema/context"
       xsi:schemaLocation="http://www.springframework.org/schema/beans
                           http://www.springframework.org/schema/beans/spring-beans.xsd
                           http://www.springframework.org/schema/context
                           http://www.springframework.org/schema/context/spring-context.xsd">
  <context:component-scan base-package="org.springbyexample.contact.web.service"/>
  <bean class="org.springframework.web.servlet.mvc.method.annotation.RequestMappingHandlerMapping"/>
</beans>
```
A custom JSON media type is configured that will serialize the JSON with class information. This is for more complex models to handle specifying specific instances of abstract classes. Ideally this custom media type can just be used by the UI and any external APIs will the standard media type that doesn’t contain any Java class information.

**META-INF/spring/mvc/rest-json-type-converter-context.xml**

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xmlns:p="http://www.springframework.org/schema/p"
      xmlns:context="http://www.springframework.org/schema/context"
      xmlns:util="http://www.springframework.org/schema/util"
      xsi:schemaLocation="http://www.springframework.org/schema/beans
                         http://www.springframework.org/schema/beans/spring-beans.xsd
                         http://www.springframework.org/schema/context
                         http://www.springframework.org/schema/context/spring-context.xsd"

    <bean id="abstractJacksonObjectMapper" class="org.springframework.beans.factory.config.MethodInvokingFactoryBean" p:targetMethod="registerModule">
        <property name="targetObject">
            <bean class="org.springframework.http.converter.json.Jackson2ObjectMapperFactoryBean"
                  p:indentOutput="true"
                  p:simpleDateFormat="yyyy-MM-dd'T'HH:mm:ss.SSSZ">
                <property name="featuresToDisable">
                    <util:constant static-field="com.fasterxml.jackson.databind.DeserializationFeature.FAIL_ON_UNKNOWN_PROPERTIES" />
                </property>
            </bean>
        </property>
        <property name="arguments">
            <list>
                <bean class="com.fasterxml.jackson.datatype.joda.JodaModule" />
            </list>
        </property>
    </bean>


    <bean id="abstractMappingJacksonJsonView" class="org.springframework.web.servlet.view.json.MappingJackson2JsonView" abstract="true"
          p:extractValueFromSingleKeyModel="true" />

    <bean id="jacksonObjectMapper" parent="abstractJacksonObjectMapper" />

    <bean id="mappingJacksonHttpMessageConverter" parent="abstractMappingJacksonHttpMessageConverter"
          p:objectMapper-ref="jacksonObjectMapper"
          p:supportedMediaTypes="application/json" />

    <bean id="mappingJacksonJsonView" parent="abstractMappingJacksonJsonView"
          p:objectMapper-ref="jacksonObjectMapper"
          p:contentType="application/json" />

</beans>
```
2. Persistence Marshalling Code

Marshalling service persistence interfaces that are separated into read-only and persistent operations, similar to the service layer.

The find persistence interface has constants for creating request paths and the basic find methods.

**Note**

Annotations specific to Spring by Example REST Module have been removed and replaced with '...'.

```java
public interface PersistenceFindMarshallingService<R extends EntityResponseResult, FR extends EntityFindResponseResult> {
    ...
    /**
     * Find by primary key.
     */
    ... public R findById(... Integer id);
    /**
     * Find a paginated record set.
     */
    ... public FR find(... int page, ... int pageSize);
    /**
     * Find all records.
     */
    ...}
```
Example 1 Excerpt from *PersistenceFindMarshallingService* in *Spring by Example REST Module*

Save and delete are both overloaded so they would continue to work with existing backend tests, but also automatically work with Sencha stores.

**Note**

Annotations specific to Spring by Example REST Module have been removed and replaced with ‘...’.

Example 2 Excerpt from *PersistenceMarshallingService* in *Spring by Example REST Module*

3. Contact REST Code Example

The contact controller just needs to have an interface that extends `PersistenceMarshallingService` and a controller that implements that interface.

The marshalling service extends `PersistenceMarshallingService` and defines all the paths for the controller as constants.
public interface PersonMarshallingService extends PersistenceContactMarshallingService<PersonResponse, PersonFindResponse, Person> {
    final static String PATH = "/person";
    public final static String FIND_BY_ID_REQUEST = PATH + PATH_DELIM + "\{" + ID_VAR + "}";
    public final static String FIND_PAGINATED_REQUEST = PATH + PAGINATED;
    public final static String FIND_REQUEST = PATH;
    public final static String SAVE_REQUEST = PATH;
    public final static String UPDATE_REQUEST = FIND_BY_ID_REQUEST;
    public final static String DELETE_PK_REQUEST = FIND_BY_ID_REQUEST;
    public final static String DELETE_REQUEST = PATH;
}

Example 3 PersonMarshallingService

The controller primarily delegates to it's service and also defines a @RequestMapping for each method.

```java
@Controller
public class PersonController extends AbstractController<Person, PersonResponse, PersonFindResponse> implements PersonMarshallingService {
    final Logger logger = LoggerFactory.getLogger(getClass());

    @Autowired
    public PersonController(ContactService service) {
        super(service);
    }

    @Override
    @RequestMapping(value = FIND_BY_ID_REQUEST, method = RequestMethod.GET)
    public PersonResponse findById(@PathVariable(ID_VAR) Integer id) {
        logger.info("Find person. id={}", id);
        return service.findById((int)id);
    }

    @Override
    @RequestMapping(value = FIND_PAGINATED_REQUEST, method = RequestMethod.GET)
    public PersonFindResponse find(@PathVariable(PAGE_VAR) int page,
                                    @PathVariable(PAGE_SIZE_VAR) int pageSize) {
        logger.info("Find person page. page={} pageSize={}", page, pageSize);
        return service.find(page, pageSize);
    }

    @Override
    @RequestMapping(value = FIND_REQUEST, method = RequestMethod.GET)
    public PersonFindResponse find() {
        logger.info("Find all persons.");
        return service.find();
    }

    @Override
    @RequestMapping(value = SAVE_REQUEST, method = RequestMethod.POST)
    public PersonResponse create(@RequestBody Person request) {
        Assert.isTrue(!isPrimaryKeyValid(request), "Create should not have a valid primary key.");
        logger.info("Save person. id={}", request.getId());
        return service.create(request);
    }
```
@Override
@RequestMapping(value = UPDATE_REQUEST, method = RequestMethod.PUT)
public PersonResponse update(@RequestBody Person request) {
    Assert.isTrue(isPrimaryKeyValid(request), "Update should have a valid primary key.");

    logger.info("Update person. id={}", request.getId());
    return service.update(request);
}

@Override
@RequestMapping(value = DELETE_PK_REQUEST, method = RequestMethod.DELETE)
public PersonResponse delete(@PathVariable(ID_VAR) Integer id) {
    logger.info("Delete person. id={}", id);
    return service.delete(new Person().withId(id));
}

@Override
@RequestMapping(value = DELETE_REQUEST, method = RequestMethod.DELETE)
public PersonResponse delete(@RequestBody Person request) {
    Assert.isTrue((request.getId() > 0), "Delete should have a valid primary key");
    int id = request.getId();
    return delete(id);
}

Example 4 PersonController

4. REST Client

Spring Configuration

The REST client configuration creates a RestTemplate and leverages the same marshellers that the server uses. The default configuration uses the JAXB marshaller, but if the Spring Profile for JSON is activated the JSON marshaller will be used for client requests.

META-INF/spring/client/rest-client-context.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:p="http://www.springframework.org/schema/p"
    xmlns:context="http://www.springframework.org/schema/context"
    xmlns:util="http://www.springframework.org/schema/util"
    xsi:schemaLocation="http://www.springframework.org/schema/beans
    http://www.springframework.org/schema/beans/spring-beans-3.2.xsd
    http://www.springframework.org/schema/context
    http://www.springframework.org/schema/context/spring-context.xsd
    http://www.springframework.org/schema/util
    http://www.springframework.org/schema/util/spring-util.xsd">
    <import resource="classpath:/META-INF/spring/marshaller/jaxb2-marshaller-context.xml"/>
    <context:component-scan base-package="org.springbyexample.contact.web.client" />
```
Client Code

The RestClient configures the RestTemplate with the default credentials, and also can create URLs from a URI.

```java
@Component
class RestClient {

    final Logger logger = LoggerFactory.getLogger(getClass());

    private final RestTemplate template;
    private final RestClientProperties clientProperties;
    private final DefaultHttpClient httpClient;

    @Autowired
    public RestClient(RestTemplate template, RestClientProperties clientProperties,
        DefaultHttpClient httpClient) {
        this.template = template;
        this.clientProperties = clientProperties;
        this.httpClient = httpClient;
    }

    @PostConstruct
    public void init() {
        setCredentials(clientProperties.getUsername(), clientProperties.getPassword());
    }
}
```
public RestTemplate getRestTemplate() {
  return template;
}

/**
 * Creates URL based on the URI passed in.
 */
public String createUrl(String uri) {
    StringBuilder sb = new StringBuilder();
    sb.append(clientProperties.getUrl());
    sb.append(clientProperties.getApiPath());
    sb.append(uri);
    logger.debug("URL is '{}'.", sb.toString());
    return sb.toString();
}

/**
 * Set default credentials on HTTP client.
 */
public void setCredentials(String userName, String password) {
    UsernamePasswordCredentials creds =
        new UsernamePasswordCredentials(clientProperties.getUsername(),
        clientProperties.getPassword());
    AuthScope authScope = new AuthScope(AuthScope.ANY_HOST, AuthScope.ANY_PORT,
    AuthScope.ANY_REALM);
    httpClient.getCredentialsProvider().setCredentials(authScope, creds);
}

Example 5 RestClient in Spring by Example REST Module

Abstract persistence client base for read-only operations.

public abstract class AbstractPersistenceFindClient<R extends EntityResponseResult,
    FR extends EntityFindResponseResult>
    implements PersistenceFindMarshallingService<R, FR> {
    final Logger logger = LoggerFactory.getLogger(getClass());

    protected final RestClient client;
    private final String findByIdRequest;
    private final String findPaginatedRequest;
    private final String findRequest;
    protected final Class<R> responseClazz;
    protected final Class<FR> findResponseClazz;

    public AbstractPersistenceFindClient(RestClient client,
        String findByIdRequest, String findPaginatedRequest, String
        findRequest,
        Class<R> responseClazz, Class<FR> findResponseClazz) {
        this.client = client;
        this.findByIdRequest = findByIdRequest;
        this.findPaginatedRequest = findPaginatedRequest;
        this.findRequest = findRequest;
        this.responseClazz = responseClazz;
        this.findResponseClazz = findResponseClazz;
    }
this.findRequest = findRequest;
this.responseClazz = responseClazz;
this.findResponseClazz = findResponseClazz;
}

@Override
public R findById(Integer id) {
    R response = null;
    String url = client.createUrl(findByIdRequest);
    logger.debug("REST client findById. id={} url='{}'", id, url);
    response = client.getRestTemplate().getForObject(url, responseClazz, createPkVars(id));
    return response;
}

@Override
public FR find(int page, int pageSize) {
    FR response = null;
    String url = client.createUrl(findPaginatedRequest);
    logger.debug("REST client paginated find. page={} pageSize={} url='{}'",
                new Object[]{page, pageSize, url});
    response = client.getRestTemplate().getForObject(url, findResponseClazz,
            createPageVars(page, pageSize));
    return response;
}

@Override
public FR find() {
    FR response = null;
    String url = client.createUrl(findRequest);
    logger.debug("REST client find. url='{}'", url);
    response = client.getRestTemplate().getForObject(url, findResponseClazz);
    return response;
}

/**
 * Create primary key request variables.
 */
public Map<String, Long> createPkVars(long id) {
    return Collections.singletonMap(ID_VAR, id);
}

/**
 * Create page vars for a paginated request.
 */
public Map<String, Integer> createPageVars(int page, int pageSize) {
    Map<String, Integer> result = new HashMap<String, Integer>();
    result.put(PAGE_VAR, page);
    result.put(PAGE_SIZE_VAR, pageSize);
    return result;
}
Abstract persistence client base for persistent operations.

```java
public abstract class AbstractPersistenceClient<R extends EntityResponseResult,
FR extends EntityFindResponseResult,
S extends PkEntityBase>
    extends AbstractPersistenceFindClient<R, FR>
    implements PersistenceMarshallingService<R, FR, S> {

    private final String saveRequest;
    private final String updateRequest;
    private final String deletePkRequest;
    private final String deleteRequest;
    public AbstractPersistenceClient(RestClient client,
            String findByIdRequest, String findPaginatedRequest, String findRequest,
            String saveRequest, String updateRequest,
            String deletePkRequest, String deleteRequest,
            Class<R> responseClazz, Class<FR> findResponseClazz) {
        super(client,
                findByIdRequest, findPaginatedRequest, findRequest,
                responseClazz, findResponseClazz);
        this.saveRequest = saveRequest;
        this.updateRequest = updateRequest;
        this.deletePkRequest = deletePkRequest;
        this.deleteRequest = deleteRequest;
    }

    @Override
    public R create(S request) {
        R response = null;
        String url = client.createUrl(saveRequest);
        logger.debug("REST client save. id={} url='{}'", request.getId(), url);
        response = client.getRestTemplate().postForObject(url, request, responseClazz);
        return response;
    }

    @Override
    public R update(S request) {
        R response = null;
        String url = client.createUrl(updateRequest);
        logger.debug("REST client update. id={} url='{}'", request.getId(), url);
        Map<String, Long> vars = createPkVars(request.getId());
        response = client.getRestTemplate().exchange(url, HttpMethod.PUT, new HttpEntity(request),
                responseClazz, vars).getBody();
        return response;
    }

    public R delete(Integer id) {
        R response = null;
        String url = client.createUrl(deletePkRequest);
        logger.debug("REST client delete. id={} url='{}'", id, url);
        Map<String, Long> vars = createPkVars(id);
        response = client.getRestTemplate().exchange(url, HttpMethod.DELETE, null, responseClazz,
                vars).getBody();
    }
}
```
return response;
}

@Override
public R delete(S request) {
    throw new UnsupportedOperationException("Issue with DELETE and posting body.");
    ...
}

Example 7 AbstractPersistenceClient

The abstract base classes handle everything once all the URIs and expected responses are correctly set in the constructor.

@Component
public class PersonClient extends AbstractPersistenceClient<PersonResponse, PersonFindResponse, Person>
    implements PersonMarshallingService {

    @Autowired
    public PersonClient(RestClient client) {
        super(client,
            FIND_BY_ID_REQUEST, FIND_PAGINATED_REQUEST, FIND_REQUEST,
            SAVE_REQUEST, UPDATE_REQUEST, DELETE_PK_REQUEST, DELETE_REQUEST,
            PersonResponse.class, PersonFindResponse.class);
    }
}

Example 8 PersonClient

5. Reference

Related Links

- Contact Application Web Service Beans
- Contact Application DAO
- Contact Application Services
- Jackson Java JSON-processor [http://jackson.codehaus.org/]

Project Setup

Follow the Project Checkout instructions for git, then go to the project (relative path below).
General Setup Instructions

General instructions for checking out the project with Eclipse and building with Maven.

Example Project Setup

**Project Information**

- Spring Framework 3.2.x
The web application builds on all the other modules, so has very little configuration of it's own. It has a JSP UI, Sencha ExtJS [http://www.sencha.com/products/extjs/], and also a Sencha Touch [http://www.sencha.com/products/touch/] UI. The latter Sencha UIs both use the REST services.

1. Web Configuration

Two servlets are configured. The first one configures a JSP application and the second one is for the REST API.

Excerpt from /WEB-INF/web.xml

```xml
<servlet>
  <servlet-name>simple-form</servlet-name>
  <servlet-class>org.springframework.web.servlet.DispatcherServlet</servlet-class>
  <init-param>
    <param-name>contextConfigLocation</param-name>
    <param-value>/WEB-INF/spring/mvc/jsp-servlet-context.xml</param-value>
  </init-param>
  <load-on-startup>2</load-on-startup>
</servlet>

<servlet>
  <servlet-name>spring-mvc</servlet-name>
  <servlet-class>org.springframework.web.servlet.DispatcherServlet</servlet-class>
  <init-param>
    <param-name>contextConfigLocation</param-name>
    <param-value>/WEB-INF/spring/mvc/rest-servlet-context.xml</param-value>
  </init-param>
  <async-supported>true</async-supported>
  <load-on-startup>1</load-on-startup>
</servlet>

<servlet-mapping>
  <servlet-name>simple-form</servlet-name>
  <url-pattern>*.html</url-pattern>
</servlet-mapping>

<servlet-mapping>
  <servlet-name>spring-mvc</servlet-name>
  <url-pattern>/api/*</url-pattern>
</servlet-mapping>
```

2. Spring Configuration

All of the Spring configuration files in the root directory of 'WEB-INF/spring' are loaded in the root Spring context. This configuration is for loading anything web related into the root context, in this case it's just the web security.
Most of the main Spring configuration files from the different modules are loaded. Basic security, marshellers, DB related code, and the services layer.

The REST API servlet configuration loads the REST controllers and their views & handlers.
The JSP servlet loads the JSP controllers and configures it's static and dynamic resources. Wild card mappings are setup to serve all resources for Sencha ExtJS [http://www.sencha.com/products/extjs/] & Sencha Touch [http://www.sencha.com/products/touch/].

Also a static content zip is generated. So if a server like Apache is proxying the servlet container, it could also be configured to serve the static content.

WEB-INF/spring/mvc/jsp-servlet-context.xml

```xml
<import resource="classpath:/META-INF/spring/web/web-rest-servlet-context.xml"/>
</beans>

<!-- Declare the Interceptor -->
<mvc:interceptors>
  <bean class="org.springframework.web.servlet.i18n.LocaleChangeInterceptor"
p: paramName="locale" />
</mvc:interceptors>

<!-- Declare the Resolver -->
<bean id="localeResolver" class="org.springframework.web.servlet.i18n.SessionLocaleResolver" />

<context:component-scan base-package="org.springbyexample.contact.web.servlet.mvc" />
<mvc:annotation-driven />
<mvc:view-controller path="/index.html" />
<mvc:view-controller path="/login.html" />
<mvc:view-controller path="/logoutSuccess.html" />
<mvc:resources mapping="/extjs/**" location="/extjs/" />
<mvc:resources mapping="/touch/**" location="/touch/" />
<bean id="tilesConfigurer"
class="org.springframework.web.servlet.view.tiles2.TilesConfigurer"
p:definitions="/WEB-INF/tiles-defs/templates.xml" />
<bean id="tilesViewResolver"
class="org.springframework.web.servlet.view.UrlBasedViewResolver"
p:viewClass="org.springbyexample.web.servlet.view.tiles2.DynamicTilesView"
p:prefix="/WEB-INF/jsp/"
p:suffix=".jsp" />
</beans>
```
3. Code Example

For the most part, the web application just takes all the other modules and their Spring config to load them in the webapp. The one exception is the implementation of the `ApplicationContextInitializer` that checks if anything has been set for the Spring Profiles system property. If nothing is set, the HSQL DB profile is used as the default Spring Profile. For production the PostgreSQL profile should be set.

```java
public class ContactApplicationContextInitializer implements
ApplicationContextInitializer<ConfigurableApplicationContext> {
    private final Logger logger = LoggerFactory.getLogger(getClass());

    private static final String SPRING_PROFILES_ACTIVE_PROPERTY = "spring.profiles.active";
    private static final String PROFILE_HSQL = "hsql";
    private final static String [] DEFAULT_ACTIVE_PROFILES = { PROFILE_HSQL };

    @Override
    public void initialize(ConfigurableApplicationContext applicationContext) {
        String springProfilesActive = System.getProperty(SPRING_PROFILES_ACTIVE_PROPERTY);
        if (StringUtils.hasText(springProfilesActive)) {
            logger.info("Using set spring profiles. profiles='{}'", springProfilesActive);
        } else {
            applicationContext.getEnvironment().setActiveProfiles(DEFAULT_ACTIVE_PROFILES);
            logger.info("Setting default spring profiles. profiles='{}'", DEFAULT_ACTIVE_PROFILES);
        }
    }
}
```

Example 1 ContactApplicationContextInitializer

4. Reference

Related Links

- Contact Application Web Service Beans
- Contact Application DAO
- Contact Application Services
- Contact Application REST Services
- Simple Spring Security Webapp

Project Setup

Follow the Project Checkout instructions for git, then go to the project (relative path below).
General Setup Instructions

General instructions for checking out the project with Eclipse and building with Maven.

Example Project Setup

DB Setup Instructions

To setup the webapp to run with PostgreSQL, follow the steps below.

- Install PostgreSQL 9.0

- Create this file in your home directory so you don't have to enter the DB password.

  `.pgpass`

  ```
  *:*:*:postgres:password
  *:*:*:contact:contact
  localhost:5432:*:postgres:password
  ```

- Initialize the DB:

  ```
  cd app/contact-app
  ./init-postgres.sh
  ```

  or for re-initializing an existing DB:

  ```
  cd app/contact-app
  ./reinit-postgres.sh
  ```

- Set the Java System Property when starting the servlet container for the Spring Profile.

  -Dspring.profiles.active=postgresql

- Create a property file with the JDBC URL to PostgreSQL in the directory where the servlet container is started.

  `contact-app.properties`
jdbc.url=jdbc:postgresql://$postgres_ip:5432/contact

Project Information

- Spring Framework 3.2.x
The DAO, Services, and REST Services all have a shared Spring Test context setup when the abstract test base for each module is extended. This will improve overall test performance since any setup by Spring will only be performed once for a suite of tests.

There is a contact-test module that is used to share abstract test base classes, constants used across layers, and any shared config. This is used instead of having each module generate it’s own test artifact. When each there are a lot of test artifacts, inter-module dependencies can become more complicated.

1. Abstract Test Code

These are shared abstract base classes for tests in different modules to extend.

Abstract Code

The AbstractProfileTest sets up the main JUnit Spring test runner and sets the default Spring Active Profile to use the HSQL DB. All of the tests from each module extend this class.

```java
@RunWith(SpringJUnit4ClassRunner.class)
@ActiveProfiles(profiles= { HSQL })
public abstract class AbstractProfileTest {

    /**
     * Setup the security context before each test.
     */
    @Before
    public void setUp() {
        doInit();
    }

    /**
     * Clear the security context after each test.
     */
    @After
    public void tearDown() {
        SecurityContextHolder.clearContext();
    }

    /**
     * Set the default user on the security context.
     */
    protected abstract void doInit();
}
```

Example 1 AbstractProfileTest in Spring by Example REST Module
The DAO and Service tests extend this abstract class. It extends AbstractProfileTest, sets up the Spring transactional test configuration, and also configures a default security context. The Spring transactional test configuration provides automatic transaction rollback as each individual test finishes. Having the security context set before each test is to reset it to the default in case an individual test made any changes to test different users.

```
@TransactionConfiguration
@Transactional
public abstract class AbstractTransactionalProfileTest extends AbstractProfileTest {

    /**
     * Set the default user on the security context.
     */
    protected void doInit() {
        SecurityContextHolder.getContext().setAuthentication(
            new UsernamePasswordAuthenticationToken(DEFAULT_SECURITY_USER,
                DEFAULT_SECURITY_USER_PASSWORD));
    }
}
```

Example 2 AbstractTransactionalProfileTest

2. DAO Test

The DAO tests and their test base are for testing the JPA entities & Spring Data JPA [http://www.springsource.org/spring-data/jpa] repositories against an in-memory database.

Spring Configuration

The DAO test config is very simple and just loads all of the DB Spring configuration files. All Spring XML configuration files end in -context.xml and test ones end in -test-context.xml

dao-test-context.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:p="http://www.springframework.org/schema/p"
    xmlns:context="http://www.springframework.org/schema/context"
    xsi:schemaLocation="http://www.springframework.org/schema/beans
        http://www.springframework.org/schema/beans/spring-beans.xsd
        http://www.springframework.org/schema/context
        http://www.springframework.org/schema/context/spring-context.xsd">

    <import resource="classpath*:META-INF/spring/db/**/*-context.xml"/>

</beans>
```
Abstract Code

Most of the test configuration was already configured in the parent test classes. All that is left is to configure the test Spring configuration to use by setting the @ContextConfiguration. As each test extending this class runs, it will automatically use this shared Spring test context.

```java
@ContextConfiguration({ "classpath:/dao-test-context.xml" })
public abstract class AbstractRepositoryTest extends AbstractTransactionalProfileTest {
}
```

Example 3 AbstractRepositoryTest

Code Example

The person repository test is for the Spring Data JPA [http://www.springsource.org/spring-data/jpa] PersonRepository. There is in progress work for having Person subclasses work through the entire stack.

```java
public class PersonRepositoryTest extends AbstractRepositoryTest {
    private final Logger logger = LoggerFactory.getLogger(PersonRepositoryTest.class);

    @Autowired
    private PersonRepository personRepository;

    @Autowired
    private ProfessionalRepository professionalRepository;

    @Test
    public void testFindOne() {
        Person person = personRepository.findOne(FIRST_ID);
        testPersonOne(person);
    }

    @Test
    public void testFindAll() {
        Collection<Person> persons = personRepository.findAll();
        assertNotNull("Person list is null.", persons);
        assertEquals("Number of persons should be " + EXPECTED_COUNT + ".", EXPECTED_COUNT,
                persons.size());
        for (Person person : persons) {
            logger.debug(person.toString());
            if (FIRST_ID.equals(person.getId())) {
                testPersonOne(person);
            } else if (SECOND_ID.equals(person.getId())) {
                testPersonTwo(person);
            }
        }
    }

    @Test
    public void testFindByFirstNameLike() {
        List<Person> persons = personRepository.findByFirstNameLike("J%");
    }
}
int expectedCount = 2;
assertNotNull("Person list is null.", persons);
assertEquals("Number of persons should be "+ expectedCount + ".", expectedCount,
persons.size());

Person person = persons.get(0);
testPersonOne(person);

@Test
public void testFindByLastName() {
    List<Person> persons = personRepository.findByLastName(LAST_NAME);
    int expectedCount = 1;
    assertNotNull("Person list is null.", persons);
    assertEquals("Number of persons should be "+ expectedCount + ".", expectedCount,
persons.size());
    Person person = persons.get(0);
testPersonOne(person);
}

@Test
public void testFindByAddress() {
    List<Person> persons = personRepository.findByAddress(ADDR);
    int expectedCount = 1;
    assertNotNull("Person list is null.", persons);
    assertEquals("Number of persons should be "+ expectedCount + ".", expectedCount,
persons.size());
    Person person = persons.get(0);
testPersonOne(person);
}

@Test
public void testFindByAddressPage() {
    String firstName = "Jack";
    String lastName = "Johnson";
    String companyName = "Spring Pizza";
    int page = 0;
    int size = 10;
    for (int i = 0; i < 35; i++) {
        createProfessional(firstName, lastName, companyName, ADDR);
    }
    Page<Person> pageResult = personRepository.findByAddress(ADDR,
new PageRequest(page, size));
    List<Person> persons = pageResult.getContent();
    int expectedCount = size;
    assertNotNull("Person list is null.", persons);
    assertEquals("Number of persons should be "+ expectedCount + ".", expectedCount,
persons.size());
    // query last page
    page = pageResult.getTotalPages() - 1;
    pageResult = personRepository.findByAddress(ADDR, new PageRequest(page, size));
    persons = pageResult.getContent();
    // created 35 records with the same address, one existing
    expectedCount = 6;
assertNotNull("Person list is null.", persons);
assertEquals("Number of persons should be "+ expectedCount + ".", expectedCount, persons.size());
}

@Test
public void testFindByName() {
    List<Person> persons = personRepository.findByName(FIRST_NAME, LAST_NAME);
    int expectedCount = 1;
    assertNotNull("Person list is null.", persons);
    assertEquals("Number of persons should be "+ expectedCount + ".", expectedCount, persons.size());
    Person person = persons.get(0);
    testPersonOne(person);
}

@Test
public void testSave() {
    String firstName = "Jack";
    String lastName = "Johnson";
    String companyName = "Spring Pizza";
    Person person = createProfessional(firstName, lastName, companyName, ADDR);
    // get PK of first address
    Integer addressId = person.getAddresses().iterator().next().getId();
    // test saved person
    testPerson(person,
               firstName, lastName,
               EXPECTED_ADDRESS_COUNT, addressId, ADDR, CITY, STATE, ZIP_POSTAL,
               true, companyName);
    person = professionalRepository.findOne(person.getId());
    // test retrieved person just saved
    testPerson(person,
               firstName, lastName,
               EXPECTED_ADDRESS_COUNT, addressId, ADDR, CITY, STATE, ZIP_POSTAL,
               true, companyName);
    Collection<Person> persons = personRepository.findAll();
    int expectedCount = EXPECTED_COUNT + 1;
    assertNotNull("Person list is null.", persons);
    assertEquals("Number of persons should be "+ expectedCount + ".", expectedCount, persons.size());
}

@Test
public void testUpdate() {
    Person person = personRepository.findOne(FIRST_ID);
    testPersonOne(person);
    String lastName = "Jones";
    person.setLastName(lastName);
    personRepository.saveAndFlush(person);
    person = personRepository.findOne(FIRST_ID);
    testPersonOne(person, lastName);
}

@Test
public void testDelete() {
    Contact Application Test
    Spring by Example Version 1.3 Spring by Example 251
```java
personRepository.delete(FIRST_ID);

// person should be null after delete
Person person = personRepository.findOne(FIRST_ID);
assertNull("Person is not null.", person);

/**
 * Create professional.
 */
private Person createProfessional(String firstName, String lastName, String companyName,
String addr) {
    Professional person = new Professional();
    Set<Address> addresses = new HashSet<Address>();
    Address address = new Address();
    addresses.add(address);
    address.setAddress(addr);
    address.setCity(CITY);
    address.setState(STATE);
    address.setZipPostal(ZIP_POSTAL);
    address.setCountry(COUNTRY);
    person.setFirstName(firstName);
    person.setLastName(lastName);
    person.setCompanyName(companyName);
    person.setAddresses(addresses);
    Person result = personRepository.saveAndFlush(person);
    return result;
}

/**
 * Tests person with a PK of one.
 */
private void testPersonOne(Person person) {
    testPersonOne(person, LAST_NAME);
}

/**
 * Tests person with a PK of one.
 */
private void testPersonOne(Person person, String lastName) {
    String schoolName = "NYU";
    Integer addressId = new Integer(1);
    testPerson(person,
            FIRST_NAME, lastName,
            EXPECTED_ADDRESS_COUNT, addressId, ADDR, CITY, STATE, ZIP_POSTAL,
            false, schoolName);
}

/**
 * Tests person with a PK of two.
 */
private void testPersonTwo(Person person) {
    String firstName = "John";
    String lastName = "Wilson";
    String companyName = "Spring Pizza";
    int expectedAddresses = 2;
    Integer addressId = new Integer(3);
    String addr = "47 Howard St.";
    String city = "San Francisco";
    String state = "CA";
    String zipPostal = "94103";
    testPerson(person,
```
private void testPerson(Person person,
   String firstName, String lastName,
   int expectedAddresses, Integer addressId,
   String addr, String city, String state, String zipPostal,
   boolean professional, String professionName) {
    assertNotNull("Person is null.", person);
    assertEquals("firstName", firstName, person.getFirstName());
    assertEquals("lastName", lastName, person.getLastName());
    assertNotNull("Person's address list is null.", person.getAddresses());
    assertEquals("addresses", expectedAddresses, person.getAddresses().size());
    // if (professional) {
    //    assertTrue("Person should be an instance of professional.", (person instanceof Professional));
    //    assertEquals("companyName", professionName, ((Professional)person).getCompanyName());
    // } else {
    //    assertTrue("Person should be an instance of student.", (person instanceof Student));
    //    assertEquals("schoolName", professionName, ((Student)person).getSchoolName());
    // }
    for (Address address : person.getAddresses()) {
        assertNotNull("Address is null.", address);
        if (addressId.equals(address.getId())) {
            assertEquals("address.id", addressId, address.getId());
            assertEquals("address.addr", addr, address.getAddress());
            assertEquals("address.city", city, address.getCity());
            assertEquals("address.state", state, address.getState());
            assertEquals("address.zipPostal" + zipPostal + ".", zipPostal,
                address.getZipPostal());
            assertEquals("address.country", COUNTRY, address.getCountry());
            testAuditable(address);
        }
    }
    testAuditable(person);
}

private void testAuditable(AbstractAuditableEntity auditRecord) {
    assertNotNull("lastUpdated", auditRecord.getLastModifiedDate());
    assertNotNull("lastUpdatedBy", auditRecord.getLastModifiedBy());
    assertNotNull("created", auditRecord.getCreatedDate());
    assertNotNull("createdBy", auditRecord.getCreatedBy());
}

Example 4 PersonRepositoryTest

3. Services Test
The Services tests and their test base are for testing the services use of the Spring Data JPA [http://www.springsource.org/spring-data/jpa] repositories, conversion between the entity and ws bean models, and business logic (if any). Also security and transactional configuration are loaded and used during the tests. All database operations are performed against an in-memory database.

**Spring Configuration**

The Services Spring test configuration loads the main security, marshaller, DB, and services config. It doesn't use any special test configuration or mocks, but anything different from the standard production Spring configuration could be added here.

*services-test-context.xml*

```
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xmlns:p="http://www.springframework.org/schema/p"
      xmlns:context="http://www.springframework.org/schema/context"
      xsi:schemaLocation="http://www.springframework.org/schema/beans
          http://www.springframework.org/schema/beans/spring-beans.xsd
          http://www.springframework.org/schema/context
          http://www.springframework.org/schema/context/spring-context.xsd">
  <import resource="classpath*:META-INF/spring/security/**/*-context.xml"/>
  <import resource="classpath*:META-INF/spring/marshaller/**/*-context.xml"/>
  <import resource="classpath*:META-INF/spring/db/**/*-context.xml"/>
  <import resource="classpath*:META-INF/spring/services/**/*-context.xml"/>
</beans>
```

**Abstract Code**

The AbstractServiceTest extends the shared transactional profile test abstract class. It sets the shared test configuration to *services-test-context.xml*.

```
@ContextConfiguration({"classpath:/services-test-context.xml"})
public abstract class AbstractServiceTest extends AbstractTransactionalProfileTest {

}
```

*Example 5 AbstractServiceTest*

**Code Example**

The ContactServiceTest tests the basic usage of the ContactService. This primarily covers usage of it's JPA repository and conversion to and from entity beans & ws beans.
public class ContactServiceTest extends AbstractServiceTest {

    final Logger logger = LoggerFactory.getLogger(ContactServiceTest.class);

    @Autowired
    private ContactService service;

    @Test
    public void testFindById() {
        PersonResponse response = service.findById(FIRST_ID);
        Person person = response.getResults();
        testPersonOne(person);
    }

    @Test
    public void testFindByLastName() {
        PersonFindResponse response = service.findByLastName(LAST_NAME);
        List<Person> results = response.getResults();
        int expectedCount = 1;
        assertNotNull("Person list is null.", results);
        assertEquals("Number of persons should be " + expectedCount + ".", expectedCount, results.size());
        Person person = response.getResults().get(0);
        testPersonOne(person);
    }

    @Test
    public void testFind() {
        PersonFindResponse response = service.find();
        assertNotNull("Person response is null.", response);
        Collection<Person> persons = response.getResults();
        assertNotNull("Person list is null.", persons);
        assertEquals("Number of persons should be " + EXPECTED_COUNT + ".", EXPECTED_COUNT, persons.size());
        for (Person person : persons) {
            logger.debug(person.toString());
            if (FIRST_ID.equals(person.getId())) {
                testPersonOne(person);
            } else if (SECOND_ID.equals(person.getId())) {
                testPersonTwo(person);
            }
        }
    }

    @Test
    public void testCreate() {
        String firstName = "Jack";
        String lastName = "Johnson";
        PersonResponse response = createPerson(firstName, lastName);
        assertNotNull("Person response is null.", response);
        Person person = response.getResults();
        // test saved person
        testPerson(person, firstName, lastName);
        PersonFindResponse findResponse = service.find();
        assertNotNull("Person response is null.", findResponse);
    }
}
Collection<Person> persons = findResponse.getResults();

int expectedCount = EXPECTED_COUNT + 1;

assertNotNull("Person list is null.", persons);
assertEquals("Number of persons should be "+ expectedCount + ".", expectedCount, persons.size());
}

@Test
public void testUpdate() {
    PersonResponse response = service.findById(FIRST_ID);
    assertNotNull("Person response is null.", response);

    Person person = response.getResults();
    testPersonOne(person);

    String lastName = "Jones";
    person.setLastName(lastName);
    service.update(person);

    response = service.findById(FIRST_ID);
    assertNotNull("Person response is null.", response);
    person = response.getResults();
    testPersonOne(person, lastName);
}

@Test
public void testDelete() {
    service.delete(new Person().withId(FIRST_ID));
    // person should be null after delete
    PersonResponse response = service.findById(FIRST_ID);
    assertNotNull("Person response is null.", response);
    Person person = response.getResults();
    assertNotNull("Person is not null.", person);
}

/**
 * Create person.
 */
private PersonResponse createPerson(String firstName, String lastName) {
    Person person = new Person();
    person.setFirstName(firstName);
    person.setLastName(lastName);

    PersonResponse response = service.create(person);
    return response;
}

/**
 * Tests person with a PK of one.
 */
private void testPersonOne(Person person) {
    testPersonOne(person, LAST_NAME);
}

/**
 * Tests person with a PK of one.
 */
private void testPersonOne(Person person, String lastName) {
    testPerson(person,
FIRST_NAME, lastName);
}
/**
 * Tests person with a PK of two.
 */
private void testPersonTwo(Person person) {
    String firstName = "John";
    String lastName = "Wilson";

    testPerson(person,
                firstName, lastName);
}
/**
 * Tests person.
 */
private void testPerson(Person person,
                        String firstName, String lastName) {
    assertNotNull("Person is null.", person);
    assertEquals("firstName", firstName, person.getFirstName());
    assertEquals("lastName", lastName, person.getLastName());
    testAuditable(person);
}
/**
 * Tests auditable entity.
 */
private void testAuditable(PkEntityBase auditRecord) {
    assertNotNull("lastUpdated", auditRecord.getLastUpdated());
    assertNotNull("lastUpdatedBy", auditRecord.getLastUpdateUser());
    assertNotNull("created", auditRecord.getCreated());
    assertNotNull("createdBy", auditRecord.getCreateUser());
}

Example 6 ContactServiceTest

4. REST Services Test

The REST Services tests and their test base are for testing the REST clients and services configuration, as well as their calls into the service layer. There is an in memory database and controllers are loaded in an embedded jetty server.

Spring Configuration

There are actually two main Spring contexts. One is the standard test context that just loads the REST clients and a properties file to configure the path to the REST APIs and any other client configuration information.

The other context is loaded in the EmbeddedJetty bean. It takes the list of Spring configuration files and loads them in a parent context, then a servlet child context is created. It also registers the Spring Security filter with the servlet handler.

rest-controller-test-context.xml
Abstract Code

The AbstractRestControllerTest sets up the shared Spring test configuration, and before each test resets the DB by re-initializing the schema and clearing the JPA entity manager cache.

```java
@ContextConfiguration({ "classpath:/org/springbyexample/web/mvc/rest-controller-test-context.xml" })
public abstract class AbstractRestControllerTest extends AbstractProfileTest {
    final Logger logger = LoggerFactory.getLogger(AbstractRestControllerTest.class);
    @Autowired
    private EmbeddedJetty embeddedJetty;

    /**
     * Reset the DB before each test.
     */
    @Override
    protected void doInit() {
        reset();
    }

    /**
     * Reset the database and entity manager cache.
     */
    protected void reset() {
```
Example 7 AbstractRestControllerTest in Spring by Example REST Module

The AbstractPersistenceFindControllerTest provides an abstract base for testing a PersistenceFindMarshallingService.
/**
 * Gets find client.
 */
protected abstract PersistenceFindMarshallingService<R, FR> getFindClient();

/**
 * Tests if record is create valid.
 */
protected void verifyRecord(S record) {
    verifyRecord(record, false, false);
}

/**
 * Tests if record is valid and can specify whether or not it was a save.
 */
protected abstract void verifyRecord(S record, boolean save, boolean update);

@Test
@SuppressWarnings("unchecked")
public void testFindById() {
    R response = getFindClient().findById(id);
    assertNotNull("Response is null.", response);
    verifyRecord((S) response.getResults());
}

@Test
@SuppressWarnings("unchecked")
public void testPaginatedFind() {
    int page = 0;
    int pageSize = 2;
    FR response = getFindClient().find(page, pageSize);
    assertNotNull("Response is null.", response);
    assertEquals("count", expectedCount, response.getCount());
    assertNotNull("Response results is null.", response.getResults());
    verifyRecord((S) response.getResults().get(0));
}

@Test
@SuppressWarnings("unchecked")
public void testFind() {
    FR response = getFindClient().find();
    assertNotNull("Response is null.", response);
    assertEquals("count", expectedCount, response.getCount());
    assertNotNull("Response results is null.", response.getResults());
    verifyRecord((S) response.getResults().get(0));
}

/**
 * Tests if audit info is valid.
 */
protected void verifyAuditInfo(DateTime lastUpdated, String lastUpdateUser,
    DateTime created, String createUser) {
    DateTime now = DateTime.now();
    assertNotNull("'lastUpdated' is null", lastUpdated);
    assertNotNull("'lastUpdateUser' is null", lastUpdateUser);
    assertNotNull("'created' is null", created);
    assertNotNull("'createUser' is null", createUser);
    assertTrue("'lastUpdated' should be before now.", (lastUpdated.isBefore(now)));
    assertTrue("'created' should be before now.", (created.isBefore(now)));
}
Example 8 AbstractPersistenceFindControllerTest in Spring by Example REST Module

The AbstractPersistenceControllerTest provides an abstract base for testing a PersistenceMarshallingService.

```java
public abstract class AbstractPersistenceControllerTest<R extends EntityResponseResult, FR extends EntityFindResponseResult, S extends PkEntityBase>
    extends AbstractPersistenceFindControllerTest<R, FR, S> {
    protected final Logger logger = LoggerFactory.getLogger(getClass());
    public AbstractPersistenceControllerTest(int id, long expectedCount) {
        super(id, expectedCount);
    }

    /**
     * Gets find client.
     */
    @Override
    protected PersistenceFindMarshallingService<R, FR> getFindClient() {
        return getClient();
    }

    /**
     * Gets client.
     */
    protected abstract PersistenceMarshallingService<R, FR, S> getClient();

    /**
     * Generate create request.
     */
    protected abstract S generateCreateRequest();

    /**
     * Generate update request.
     */
    protected abstract S generateUpdateRequest(S request);

    /**
     * Generate delete request.
     */
    protected abstract S generateDeleteRequest();

    /**
     * Tests if record valid, update is set to <code>false</code>.
     */
    protected void verifyRecord(S record, boolean save) {
        verifyRecord(record, save, false);
    }

    @Test
    @SuppressWarnings("unchecked")
    public void testCreate() {
        S request = generateCreateRequest();
        R response = getClient().create(request);
        assertNotNull("Response is null.", response);
        verifyRecord((S) response.getResults(), true);
    }
}
```
```java
int expectedCount = 1;
assertEquals("messageList.size", expectedCount, response.getMessageList().size());
logger.info(response.getMessageList().get(0).getMessage());
}

@Test
@SuppressWarnings("unchecked")
public void testUpdate() {
    S request = generateCreateRequest();
    R response = getClient().create(request);
    assertNotNull("Response is null.", response);
    verifyRecord((S) response.getResults(), true);
    int expectedCount = 1;
    assertEquals("messageList.size", expectedCount, response.getMessageList().size());
    request = generateUpdateRequest((S) response.getResults());
    response = getClient().update(request);
    verifyRecord((S) response.getResults(), true, true);
    logger.info(response.getMessageList().get(0).getMessage());
}

@Test
public void testDeletePk() {
    R response = getClient().delete(generateDeleteRequest());
    assertNotNull("Response is null.", response);
    int expectedCount = 1;
    assertEquals("messageList.size", expectedCount, response.getMessageList().size());
    logger.info(response.getMessageList().get(0).getMessage());
}

/**
 * Tests if primary key is valid.
 */
protected void verifyPrimaryKey(int id, boolean save) {
    if (!save) {
        assertEquals("'id'", id, this.id);
    } else {
        assertTrue("Primary key should be greater than zero.", (id > 0));
    }
}
```

**Example 9 AbstractPersistenceControllerTest in Spring by Example REST Module**

**Code Example**

Since all of the main testing for the PersistenceMarshallingService client is in the parent classes, just the constructor and a few methods need to be implemented. The constructor takes the primary key used by find tests and the expected count for retrieving all records. The methods implemented are `getClient()` to return this test's client, the request to be saved, and a verification method.
public class PersonControllerTest extends AbstractPersistenceContactControllerTest<PersonResponse, PersonFindResponse, Person> {

    @Autowired
    private final PersonClient client = null;

    public PersonControllerTest() {
        super(1, 3);
    }

    @Override
    protected PersistenceMarshallingService<PersonResponse, PersonFindResponse, Person> getClient() {
        return client;
    }

    @Override
    protected Person generateCreateRequest() {
        return new Person().withFirstName(FIRST_NAME).withLastName(LAST_NAME);
    }

    @Override
    protected Person generateUpdateRequest(Person request) {
        return request.withLastName(NEW_LAST_NAME);
    }

    @Override
    protected Person generateDeleteRequest() {
        return new Person().withId(id);
    }

    @Override
    protected void verifyRecord(Person record, boolean save, boolean update) {
        assertNotNull("Result is null.", record);

        verifyPrimaryKey(record.getId(), save);

        assertEquals("'firstName'", FIRST_NAME, record.getFirstName());
        if (!update) {
            assertEquals("'lastName'", LAST_NAME, record.getLastName());
        } else {
            assertEquals("'lastName'", NEW_LAST_NAME, record.getLastName());
        }

        verifyAuditInfo(record.getLastUpdated(), record.getLastName(), record.getCreated(), record.getCreateUser());

        logger.debug("id=" + record.getId() + ", firstName=" + record.getFirstName() + ", lastName=" + record.getLastName() + ", lastUpdated=" + record.getLastUpdated() + ", lastUpdateUser=" + record.getLastUpdateUser() + ", created=" + record.getCreated() + ", createUser=" + record.getCreateUser());
    }
}

Example 10 PersonControllerTest

5. Reference
Related Links

- Contact Application Web Service Beans
- Contact Application DAO
- Contact Application Services
- Contact Application REST Services

Project Setup

Follow the Project Checkout instructions for git, then go to the project (relative path below).

```
$ cd app/contact-app/contact-test
```

General Setup Instructions

General instructions for checking out the project with Eclipse and building with Maven.

Example Project Setup

Project Information

- Spring Framework 3.2.x
Part VII. Spring dm Server

This section is on developing with the Spring dm Server and OSGi based development.

OSGi (Open Services Gateway interface) is a specification maintained by the OSGi Alliance [http://www.osgi.org/]. It was founded in March 1999. One of the goals of OSGi is to reduce complexity by having much better modularity and deployment of libraries and services. The increased modularity primarily comes from a much more fine grained classloading mechanism compared to a standard JVM or Java EE container. Libraries and packages needed at runtime must be explicitly defined and even the version or version ranges required can be specified. Also, what interfaces or classes your library exports are also clearly defined. A library (JAR archive) in OSGi terminology is referred to as a bundle.


The Spring dm Server [http://www.springsource.com/products/suite/dmserver] is also an OSGi server and is actually built on top of Equinox [http://www.eclipse.org/equinox/]. Although many customizations and enhancements have been done to make it easier to manage and deploy bundles. Some of the enhancements are customizations to make it easier to deploy Spring bundles and also for deploying web bundles. In fact, standard WARs can be deployed as they are to any web container. Web modules can also be deployed as a thin WAR that uses OSGi imports to resolve any JARs instead of having them embedded in ./WEB-INF/lib and also a more OSGi like web solution which will be shown in the next basic example.

SpringSource [http://www.springsource.com/] has made a very nice plugin for developing OSGi bundles and working with the Spring dm Server [http://www.springsource.com/products/suite/dmserver] on the Eclipse IDE [http://www.eclipse.org/]. The plugin provides project templates for a basic bundle and also a type called PAR. A PAR is a way to group together related bundles and deploy them together. The plugin also has Server support in the IDE that allows deploying projects to the server. As changes are made to your project, it will automatically keep deploying any changes to the bundle to the server. Also, when managing the project any OSGi bundle from the SpringSource [http://www.springsource.com/] can be downloaded directly into the Spring dm Server [http://www.springsource.com/products/suite/dmserver].

If you haven't already installed the IDE support for this and would like to run the examples, please refer to the Setup Appendix.
Simple Message Service

David Winterfeldt
2008

There are three OSGi bundles in this example. Two are different versions of a bundle that exposes a message interface as an OSGi service. Each bundle depends on a different version of Commons Lang to demonstrate the side-by-side versioning capabilities of OSGi. The third bundle is a web module that displays the result from calling the OSGi message service. The example was made to be deployed on the Spring dm Server [http://www.springsource.com/products-suite/dmserver].

Note

Currently the examples are setup to only run from the Eclipse environment and to be deployed using the Spring dm Server [http://www.springsource.com/products-suite/dmserver]'s IDE integration. A Maven build will eventually be added.

1. Message Service Bundle 1.0

Manifest Configuration

The manifest defines the services name, description, it’s symbolic name (will deployed under this name), version, and whatever libraries, bundles, and/or packages it imports. Also, whatever packages are exported are also defined.

Note

If when opening the manifest and viewing the Dependencies tab in the Eclipse IDE, there isn’t an 'Import Bundle' section on the right and an 'Import Library' section underneath it the default Eclipse manifest editor may have been opened. To open the Spring manifest editor, right click 'Open with/Other...', and then choose the 'Bundle Manifest Editor'.

src/main/resources/META-INF/MANIFEST.MF

<manifest-version:1.0>
Bundle-Name: Simple Service Bundle
Bundle-Description: Simple Service
Bundle-ManifestVersion: 2
Bundle-SymbolicName: org.springbyexample.sdms.message.messageService
Bundle-Version: 1.0.0
Import-Library: org.aspectj,
org.springframework
Import-Bundle: com.springsource.org.apache.commons.lang;version="[2.1.0,2.1.0]"
Export-Package: org.springbyexample.sdms.message.service;version="1.0.0"
The symbolic name the bundle is deployed under and another bundle could use to reference it.

The version the bundle is deployed under.

The Import-Bundle property imports the package com.springsource.org.apache.commons.lang, version 2.1.0.

The Export-Package property exposes any packages for external use by other bundles. This exposes the package org.springbyexample.sdms.message.service which has the MessageService interface as version 1.0.0.

**Spring Configuration**

By default any spring configuration files in the META-INF/spring will be processed (this is configurable). Following the naming conventions setup by Spring Dynamic Modules for OSGi(tm) Service Platforms [http://www.springsource.org/osgi] there are two Spring configuration files. One is called bundle-context.xml and the other is called bundle-context-osgi.xml. The first one is for standard Spring configuration and the latter is meant for Spring Dynamic Modules [http://www.springsource.org/osgi] specific configuration. Like exposing OSGi services or defining services as bean references.

The MessageServiceImpl is defined as a messageService bean which will be exposed as a service in the bundle-context-osgi.xml configuration file. Spring's context:component-scan could have also been used, but wasn't just to keep the example a little more clear.

```
src/main/resources/META-INF/spring/bundle-context.xml

<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xmlns:p="http://www.springframework.org/schema/p"
      xsi:schemaLocation="http://www.springframework.org/schema/beans
                        http://www.springframework.org/schema/beans/spring-beans.xsd">
  <bean id="messageService"
        class="org.springbyexample.sdms.message.service.impl.MessageServiceImpl"
        p:message="Greetings!">
  </bean>
</beans>
```

The Spring Dynamic Modules [http://www.springsource.org/osgi]’ namespace is setup as the default namespace for the configuration file. The service element exposes the messageService bean as an OSGi service under the interface org.springbyexample.sdms.message.service.MessageService.

```
src/main/resources/META-INF/spring/bundle-context-osgi.xml

<?xml version="1.0" encoding="UTF-8"?>
<beans:beans xmlns="http://www.springframework.org/schema/osgi"
             xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
             xmlns:beans="http://www.springframework.org/schema/beans"
             xsi:schemaLocation="http://www.springframework.org/schema/osgi
                                 http://www.springframework.org/schema/osgi/spring-osgi.xsd">
  <service ref="messageService"/>
</beans:beans>
```
Code Example

The code consists of the MessageService interface and the implementation MessageServiceImpl. It's just an interface to get a message and the implementation uses Commons Lang.

Example 1 Message Service MessageService (version 1.0)

This implementation uses FastDateFormat from Commons Lang 2.1.0 to display a formatted date after the message that will be injected from the Spring configuration.

```java
public class MessageServiceImpl implements MessageService {
    private String message = null;

    /**
     * Gets message.
     */
    public String getMessage() {
        StringBuffer sb = new StringBuffer();
        sb.append(message);
        sb.append(" [ identifies thefastDateFormat.getinstance("MM/dd/yy").format(new Date())));
        sb.append("");
        return sb.toString();
    }

    /**
     * Sets message.
     */
    public void setMessage(String message) {
        this.message = message;
    }
}
```
2. Message Service Bundle 1.1

Manifest Configuration

This is the same as the 1.0 version of the Message Service bundle, but it has it's version set to 1.1.0 on the Bundle-Version property and also depends on Commons Lang 2.4.0.

```
Manifest-Version: 1.0
Bundle-Name: Simple Service Bundle
Bundle-Description: Simple Service
Bundle-ManifestVersion: 2
Bundle-SymbolicName: org.springbyexample.sdms.message.messageService
Bundle-Version: 1.1.0
Import-Library: org.aspectj;org.springframework
Import-Bundle: com.springsource.org.apache.commons.lang;version="[2.4.0,2.4.0]"
Export-Package: org.springbyexample.sdms.message.service;version="1.1.0"
```

1. The symbolic name the bundle is deployed under and another bundle could use to reference it.
2. The version the bundle is deployed under.
3. The Import-Bundle property imports the package com.springsource.org.apache.commons.lang, version 2.4.0.
4. The Export-Package property exposes any packages for external use by other bundles. This exposes the package org.springbyexample.sdms.message.service which has the MessageService interface as version 1.1.0.

Spring Configuration

The version 1.1 of MessageServiceImpl has a different message than version 1.0. Also the implementation uses a Commons Lang 2.4.0 specific method call that is appended to the message.

```
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xmlns:p="http://www.springframework.org/schema/p"
      xsi:schemaLocation="http://www.springframework.org/schema/beans
                        http://www.springframework.org/schema/beans/spring-beans.xsd">
  <bean id="messageService"
       class="org.springbyexample.sdms.message.service.impl.MessageServiceImpl"
       p:message="Greetings from Spring by Example!"/>
</beans>
```
The `messageService` bean is exposed as a service under the interface `org.springbyexample.sdms.message.service.MessageService`.

```
<?xml version="1.0" encoding="UTF-8"?>
<beans:beans xmlns="http://www.springframework.org/schema/osgi"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:beans="http://www.springframework.org/schema/beans"
  xsi:schemaLocation="http://www.springframework.org/schema/beans
  http://www.springframework.org/schema/beans/spring-beans.xsd
  http://www.springframework.org/schema/osgi
  http://www.springframework.org/schema/osgi/spring-osgi.xsd">
  <service ref="messageService"
           interface="org.springbyexample.sdms.message.service.MessageService"/>
</beans:beans>
```

### Code Example

The `MessageService` interface is identical to the one in the Message Service Bundle 1.0 class. So the Message Service Web Module can dynamically use either implementation's service.

```
public interface MessageService {
    /**
     * Gets message.
     */
    public String getMessage();
}
```

**Example 3 Message Service MessageService (version 1.1)**

This implementation uses `FastDateFormat` from Commons Lang 2.4.0 to display a formatted date after the message that will be injected from the Spring configuration. It also uses `StringUtils.length(String)` to add the message length at the end of the message. This method was adding Commons Lang 2.4.0. If you try to use this method in the Message Service Bundle 1.0 implementation, you will see that it won't be able to find that method on `StringUtils`.

```
import java.text.SimpleDateFormat;
import org.apache.commons.lang3.StringUtils;

public class MessageServiceImpl implements MessageService {
    private SimpleDateFormat dateFormat = new SimpleDateFormat("yyyy-MM-dd HH:mm:ss");

    @Override
    public String getMessage() {
        return dateFormat.format(new Date()) + " [" + StringUtils.length(this.getMessage()) + "] " + this.getMessage();
    }
}
```
public class MessageServiceImpl implements MessageService {

    private String message = null;

    /**
     * Gets message.
     */
    public String getMessage() {
        StringBuffer sb = new StringBuffer();
        sb.append(message);
        sb.append("[");
        sb.append(FastDateFormat.getInstance("MM/dd/yyyy").format(new Date()));
        sb.append("]");
        // add Commons Lang StringUtils.length(String) which was specifically added in Commons Lang
        2.4.0)
        sb.append(" (message length=*");
        sb.append(StringUtils.length(message));
        sb.append(")");
        return sb.toString();
    }

    /**
     * Sets message.
     */
    public void setMessage(String message) {
        this.message = message;
    }
}

Example 4 Message Service MessageServiceImpl (version 1.1)

3. Message Service Web Module

Manifest Configuration

The web module’s manifest is very similar to the other bundles, but it imports the taglib and servlet bundles. Also
instead of exporting a package, it imports the Message Service package exported by the Message Service bundles
and specifies that is can use version 1.0.0 through 1.1.0.

src/main/resources/META-INF/MANIFEST.MF

Manifest-Version: 1.0
Bundle-Name: Simple Service Web Module
Bundle-SymbolicName: org.springbyexample.sdms.message.webModule
Bundle-Version: 1.0.0
Bundle-Vendor: Spring by Example
Bundle-ManifestVersion: 2
Import-Bundle: com.springsource.org.apache.taglibs.standard,
    com.springsource.java.servlet
Import-Library: org.aspectj;version="[1.6.0,1.7.0]",
    org.springframework.spring;version="[2.5.5,3.0.0]"
Module-Type: Web
Web-ContextPath: message
Web-DispatcherServletUrlPatterns: *.html
The symbolic name the bundle is deployed under and another bundle could use to reference it.

The version the bundle is deployed under.

Declares the module type indicating this is a web module. This is used by the Spring dm Server [http://www.springsource.com/products/suite/dmserver].

The Web-ContextPath property configures the web application's context path.

The Web-DispatcherServletUrlPatterns property configures the dispatch servlet to route any matches for the pattern '*.html' to controllers.

The Import-Package property imports the package org.springframework.sdms.message.service which was exported by the message service bundle.

Spring Configuration

The bundle-context.xml isn't used in this example, but bundle-context-osgi.xml makes a reference to the message bundle service and exposes it as a bean. The Spring web configuration is in webmvc-context.xml.

The reference to the OSGi service MessageService is exposed as a bean named messageService.

This is just a standard Spring MVC configuration and the controller is register using context:component-scan.

Import-Package: org.springbyexample.sdms.message.service;version="[1.0.0,1.1.0]"
<bean class="org.springframework.web.servlet.mvc.annotation.DefaultAnnotationHandlerMapping">
    <property name="interceptors" ref="localeChangeInterceptor"/>
</bean>

<!-- Enables annotated POJO @Controllers -->
<bean class="org.springframework.web.servlet.mvc.annotation.AnnotationMethodHandlerAdapter"/>

<!-- Enables plain Controllers -->
<bean class="org.springframework.web.servlet.mvc.SimpleControllerHandlerAdapter"/>

<bean class="org.springframework.web.servlet.view.InternalResourceViewResolver"
    p:prefix="/WEB-INF/jsp/"
    p:suffix=".jsp"/>

<bean id="messageSource" class="org.springframework.context.support.ResourceBundleMessageSource">
    <property name="basenames">
        <value>messages</value>
    </property>
</bean>

<!-- Declare the Interceptor -->
<bean id="localeChangeInterceptor" class="org.springframework.web.servlet.i18n.LocaleChangeInterceptor">
    <property name="paramName" value="locale"/>
</bean>

<!-- Declare the Resolver -->
<bean id="localeResolver" class="org.springframework.web.servlet.i18n.SessionLocaleResolver"/>
</beans>

### JSP Example

To reduce the complexity of the example the controller just puts the message into the Model and is rendered on the page using JSTL.

src/main/resources/MODULE-INF/WEB-INF/jsp/display/index.jsp

```html
<html>
<head>
<title>Message</title>
</head>
<body>
<h1>Message</h1>
<p>${message}</p>
</body>
</html>
```

### Code Example

The controller has the message service defined in bundle-context-osgi.xml injected using @Autowired. The
display method maps to /display/index.html" and puts the results of the message service into the Model under the key 'message'.

Example 5 Message Service MessageController

```java
@Controller
public class MessageController {
    @Autowired
    protected MessageService messageService = null;

    /**
     * Displays RMI info.
     */
    @RequestMapping(value = "/display/index.html")
    public void display(Model model) {
        model.addAttribute("message", messageService.getMessage());
    }
}
```

4. Reference

Related Links

- OSGi Alliance [http://www.osgi.org/]
- Equinox [http://www.eclipse.org/equinox/]
- Adrian Colyer’s blog ‘Why should I care about OSGi anyway?’ [http://blog.springsource.com/2008/05/15/why-should-i-care-about-osgi-anyway/]
- Rob Harrop’s blog ‘Getting started with SpringSource dm Server’ [http://blog.springsource.com/2008/10/22/getting-started-with-springsource-dm-server/]

Project Setup

The project is available to checkout from an anonymous Subversion checkout.

Command Line Example

This will checkout all three projects, but each one could be checked out individually too.

```bash
$ svn co http://svn.springbyexample.org/sdms/simple-message-service/tags/1.0/ simple-message-service
```

General Setup Instructions
General instructions for checking out the project with Eclipse and building with Maven.

Example Project Setup

**Project Information**

- Spring Framework 2.5.x
- Spring dm Server 1.0
There are three OSGi bundles in this example that can either be deployed individually or as part of a PAR bundle. A PAR bundle groups together your other bundles and deploys them so they aren't visible outside the PAR. In this example since a javax.sql.DataSource is exposed an OSGi service, this feature is very useful since it's quite likely at some point to want to deploy multiple services of a similar type, but each one may be specific to an application.

This example has a DataSource bundle that exposes a DataSource OSGi service for an in memory HSQL DB. There is a JPA Bundle that exposes a Person service and uses the DataSource service. The final bundle is a web application using Spring MVC to create, edit, update, delete, and search using the Person service. The example was made to be deployed on the Spring dm Server [http://www.springsource.com/products/suite/dmserver].

**Note**

Currently the examples are setup to only run from the Eclipse environment and to be deployed using the Spring dm Server [http://www.springsource.com/products/suite/dmserver]'s IDE integration. A full Maven build will eventually be added.

The `simple-spring-mvc-par` project has a Maven build that will download and install all the libraries and bundles needed for this example. It will install in them in `${sdms.home}/repository/libraries/usr` and `${sdms.home}/repository/bundles/usr`. Just change the property 'sdms.path' in the pom.xml to the Spring dm Server [http://www.springsource.com/products/suite/dmserver] location used by Eclipse and run 'mvn package'.

### 1. Simple Spring MVC PAR

**Manifest Configuration**

There basically isn't very much to the PAR bundle since it's just a a way to group together other bundles. If you telnet into the server you'll be able to see the synthetic context the bundles were deployed under based on the PAR's bundle name. Below is a partial display of the results from running the ss.

```bash
$ telnet localhost 2401

osgi> ss
...
91 ACTIVE
org.springbyexample.sdms.simpleForm-1-org.springbyexample.sdms.simpleForm-synthetic.context_1.0.0
92 ACTIVE
org.springbyexample.sdms.simpleForm-1-org.springbyexample.sdms.simpleForm.datasource_1.0.0
93 ACTIVE
org.springbyexample.sdms.simpleForm-1-org.springbyexample.sdms.simpleForm.person_1.0.0
94 ACTIVE
org.springbyexample.sdms.simpleForm-1-org.springbyexample.sdms.simpleForm.webModule_1.0.0
```
Note

If when opening the manifest and viewing the Dependencies tab in the Eclipse IDE, it doesn't say 'PAR Editor' at the top, the default Eclipse manifest editor may have been opened. To open the Spring manifest editor, right click, 'Open with/Other...', and then choose the 'PAR Manifest Editor'.

Manifest Configuration

The manifest defines the bundles symbolic name, and imports javax.sql, Spring, HSQL DB, and Commons DBCP.

Note

If when opening the manifest and viewing the Dependencies tab in the Eclipse IDE, there isn't an 'Import Bundle' section on the right and an 'Import Library' section underneath it the default Eclipse manifest editor may have been opened. To open the Spring manifest editor, right click, 'Open with/Other...', and then choose the 'Bundle Manifest Editor'.

2. Simple Spring MVC DataSource Bundle

The DataSource bundle creates an in memory HSQL database and creates a connection pool that is exposed as an OSGi DataSource service.
The symbolic name the bundle is deployed under and another bundle could use to reference it.

The version the bundle is deployed under.

Imports the package javax.sql.

The Import-Library property imports all the related Spring bundles for the latest version of the library that can be resolved based on the version range.

Imports the HSQL DB and Commons DBCP bundles, retrieving the newest version possible based on the version ranges specified.

## Spring Configuration

By default any spring configuration files in the META-INF/spring will be processed (this is configurable). A connection pool is created using Commons DBCP to an HSQL DB and then the pool is exposed as an OSGi service.

**src/main/resources/META-INF/spring/bundle-context.xml**

```xml
<beans xmlns="http://www.springframework.org/schema/beans"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xmlns:beans="http://www.springframework.org/schema/beans"
      xsi:schemaLocation="http://www.springframework.org/schema/beans
http://www.springframework.org/schema/beans/spring-beans.xsd">
  <bean id="dataSource" class="org.apache.commons.dbcp.BasicDataSource"
        destroy-method="close">
    <property name="driverClassName" value="org.hsqldb.jdbcDriver" />
    <property name="url" value="jdbc:hsqldb:mem:person" />
    <property name="username" value="sa" />
    <property name="password" value="" />
  </bean>
</beans>
```

The Spring Dynamic Modules [http://www.springsource.org/osgi]’ namespace is setup as the default namespace for the configuration file. The service element exposes the dataSource bean as an OSGi service under the interface javax.sql.DataSource.

**src/main/resources/META-INF/spring/bundle-context-osgi.xml**

```xml
<beans:beans xmlns="http://www.springframework.org/schema/osgi"
             xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
             xmlns:beans="http://www.springframework.org/schema/beans"
             xsi:schemaLocation="http://www.springframework.org/schema/osgi
http://www.springframework.org/schema/osgi/spring-osgi-1.0.xsd
http://www.springframework.org/schema/beans
http://www.springframework.org/schema/beans/spring-beans-2.5.xsd">
  </beans:beans>
```

The Spring Dynamic Modules [http://www.springsource.org/osgi]’ namespace is setup as the default namespace for the configuration file. The service element exposes the dataSource bean as an OSGi service under the interface javax.sql.DataSource.
3. Simple Spring MVC Person DAO Bundle

The bundle uses JPA to create a Person service. The Person has a one to many relationship to Address, but to keep the example simple only the Person is used by the web module. JPA is using Hibernate for persistence.

**Manifest Configuration**

The bundle imports javax.sql, HSQL DB, Spring, and Hibernate. It also exports the package containing the Hibernate persistence beans and the Person DAO interface.

`src/main/resources/META-INF/MANIFEST.MF`

```
Manifest-Version: 1.0
Bundle-ManifestVersion: 2
Bundle-Name: Simple Spring MVC Person Bundle
Bundle-Description: Simple Spring MVC Person
Bundle-SymbolicName: org.springbyexample.sdms.simpleForm.person ❶
Bundle-Version: 1.0.0 ❷
Bundle-Vendor: Spring by Example
Import-Package: javax.sql ❸
Import-Bundle: com.springsource.org.hsqldb;version="[1.8.0,2.0.0)" ❹
Import-Library: org.springframework.spring;version="[2.5.5,3.0.0)",
   org.hibernate.ejb;version="[3.3.2.GA,3.3.2.GA]" ❺
Export-Package: org.springbyexample.sdms.simpleForm.orm.bean;version="1.0.0",
   org.springbyexample.sdms.simpleForm.orm.dao;version="1.0.0" ❻
```

❶ The symbolic name the bundle is deployed under.
❷ The version the bundle is deployed under.
❸ Imports the package javax.sql.
❹ Imports the HSQL DB bundle.
❺ The two libraries for Spring and Hibernate are resolved based on their version ranges.
❻ The package containing the persistence beans and the one with the Person DAO interface are both exported under the version 1.0.0.

**JPA Configuration**

The JPA configuration sets up Hibernate as the persistence provider and registers the two entity classes Person and Address.

`src/main/resources/META-INF/persistence.xml`
Spring Configuration

The *context:component-scan* is used to Person DAO implementation, and *tx:annotation-driven* configures Spring to process transaction annotations. A JPA transaction manager is created and JPA with i and also with the *DataSource* from the OSGi service.

**src/main/resources/META-INF/spring/bundle-context.xml**

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xsi:schemaLocation="http://www.springframework.org/schema/beans
      http://www.springframework.org/schema/beans/spring-beans.xsd"
      xmlns:context="http://www.springframework.org/schema/context"
      xmlns:tx="http://www.springframework.org/schema/tx"
      xsi:schemaLocation="http://www.springframework.org/schema/beans
      http://www.springframework.org/schema/beans/spring-beans.xsd"
      http://www.springframework.org/schema/context
      http://www.springframework.org/schema/context/spring-context.xsd"
      http://www.springframework.org/schema/tx
      http://www.springframework.org/schema/tx/spring-tx.xsd">
  <context:component-scan base-package="org.springbyexample.sdms.simpleForm.orm.impl"/>
  <tx:annotation-driven />
  <bean id="transactionManager" class="org.springframework.orm.jpa.JpaTransactionManager">
    <property name="entityManagerFactory" ref="entityManagerFactory"/>
  </bean>
  <bean id="entityManagerFactory" class="org.springframework.orm.jpa.LocalContainerEntityManagerFactoryBean">
    <property name="dataSource" ref="dataSource"/>
    <property name="jpaVendorAdapter">
      <bean class="org.springframework.orm.jpa.vendor.HibernateJpaVendorAdapter"/>
    </property>
    <property name="cacheProviderClass" value="org.hibernate.cache.HashtableCacheProvider"/>
  </bean>
</beans>
```
The `javax.sql.DataSource` exposed by the previous bundle is referenced, and the Person DAO implementation is registered as an OSGi service.

```
<?xml version="1.0" encoding="UTF-8"?>
<beans:beans xmlns="http://www.springframework.org/schema/osgi"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:beans="http://www.springframework.org/schema/beans"
xsi:schemaLocation="http://www.springframework.org/schema/osgi
http://www.springframework.org/schema/osgi/spring-osgi-1.0.xsd
http://www.springframework.org/schema/beans
http://www.springframework.org/schema/beans/spring-beans-2.5.xsd">
  <reference id="dataSource" interface="javax.sql.DataSource"/>
  <service ref="personDao" interface="org.springbyexample.sdms.simpleForm.orm.dao.PersonDao"/>
</beans:beans>
```

**Code Example**

The Person entity uses `javax.persistence` annotation for configuration.

Excerpt from `sdms/simple-spring-mvc/simple-spring-mvc-person/src/main/java/org/springbyexample/sdms/simpleForm/orm/bean/Person.java`

```java
@Entity
@Table(name="PERSON")
public class Person implements Comparable<Person>, Serializable {

  ...  
  private Integer id = null;
  private String firstName = null;
  private String lastName = null;
  private Set<Address> addresses = null;
  private Date created = null;

  /**
   * Gets id (primary key).
   */
  @Id
  @GeneratedValue(strategy=GenerationType.AUTO)
  public Integer getId() { return id; }

  /**
   * Gets firstName.
   */
  public String getFirstName() { return firstName; }

  /**
   * Gets lastName.
   */
  public String getLastName() { return lastName; }

  /**
   * Gets addresses.
   */
  public Set<Address> getAddresses() { return addresses; }

  /**
   * Gets created.
   */
  public Date getCreated() { return created; }

  @Override
  public int compareTo(Person o) {
    return o.getId().compareTo(id);
  }

  @Override
  public boolean equals(Object o) {
    if (this == o) return true;
    if (o == null || getClass() != o.getClass()) return false;
    Person person = (Person) o;
    return id.equals(person.id);
  }

  @Override
  public int hashCode() {
    return id.hashCode();
  }

  @Override
  public String toString() {
    return "Person\{id=" + id + ", firstName=" + firstName + ", lastName=" + lastName + ", addresses=" + addresses + ", created=" + created + \}"
  }
```
* Sets id (primary key).
*/
public void setId(Integer id) {
    this.id = id;
}

/**
 * Gets first name.
 */
@Column(name="FIRST_NAME")
public String getFirstName() {
    return firstName;
}

/**
 * Sets first name.
 */
public void setFirstName(String firstName) {
    this.firstName = firstName;
}

/**
 * Gets last name.
 */
@Column(name="LAST_NAME")
public String getLastName() {
    return lastName;
}

/**
 * Sets last name.
 */
public void setLastName(String lastName) {
    this.lastName = lastName;
}

/**
 * Gets list of <code>Address</code>s.
 */
@OneToMany(fetch=FetchType.EAGER, cascade=CascadeType.ALL)
@JoinColumn(name="PERSON_ID", nullable=false)
public Set<Address> getAddresses() {
    return addresses;
}

/**
 * Sets list of <code>Address</code>s.
 */
public void setAddresses(Set<Address> addresses) {
    this.addresses = addresses;
}

/**
 * Gets date created.
 */
public Date getCreated() {
    return created;
}

/**
 * Sets date created.
 */
public void setCreated(Date created) {
    this.created = created;
}

public Address findAddressById(Integer id) {
    Address result = null;
    if (addresses != null) {
        for (Address address: addresses) {
            if (address.getId().equals(id)) {
                result = address;
            }
        }
    }
    return result;
}
Example 1 Person Entity

The Person DAO implementation uses the JPA EntityManager for managing a Person.

sdms/simple-spring-mvc/simple-spring-mvc-person/src/main/java/org/springbyexample/sdms/simpleForm/orm/impl/PersonDaoImpl.java
/**
 * Saves person.
 */
@.Transactional(readOnly = false, propagation = Propagation.REQUIRES_NEW)
public Person save(Person person) {
    return em.merge(person);
}

/**
 * Deletes person.
 */
@Transactional(readOnly = false, propagation = Propagation.REQUIRES_NEW)
public void delete(Person person) {
    em.remove(em.merge(person));
}

/**
 * Saves address to person.
 */
@Transactional(readOnly = false, propagation = Propagation.REQUIRES_NEW)
public Person saveAddress(Integer id, Address address) {
    Person person = findPersonById(id);
    if (person.getAddresses().contains(address)) {
        person.getAddresses().remove(address);
    }
    person.getAddresses().add(address);
    return save(person);
}

/**
 * Deletes address from person.
 */
@Transactional(readOnly = false, propagation = Propagation.REQUIRES_NEW)
public Person deleteAddress(Integer id, Integer addressId) {
    Person person = findPersonById(id);
    Address address = new Address();
    address.setId(addressId);
    if (person.getAddresses().contains(address)) {
        person.getAddresses().remove(address);
    }
    return save(person);
}

Example 2 Person DAO Implementation

4. Simple Spring MVC Web Module

The web module has a simple form for creating and editing a Person, and also has a basic search page. The application also has internationalization and uses Tiles for templating.

Manifest Configuration
The symbolic name the bundle is deployed under.

The version the bundle is deployed under.

Declares the module type indicating this is a web module. This is used by the Spring dm Server [http://www.springsource.com/products/suite/dmserver].

The Web-ContextPath property configures the web application’s context path.

The Web-DispatcherServletUrlPatterns property configures the dispatch servlet to route any matches for the pattern ".html" to controllers.

The Import-Package property imports the persistence beans and the Person DAO interface from the Person DAO bundle.

**Spring Configuration**

The bundle-context.xml isn’t used in this example, but bundle-context-osgi.xml makes a reference to the Person service and exposes it as a bean. The Spring web configuration is in webmvc-context.xml.

The reference to the OSGi service PersonDao is exposed as a bean named personDao.

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans:beans xmlns="http://www.springframework.org/schema/osgi"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:beans="http://www.springframework.org/schema/beans"
  xsi:schemaLocation="http://www.springframework.org/schema/osgi
  http://www.springframework.org/schema/beans
  http://www.springframework.org/schema/beans/spring-beans.xsd
  http://www.springframework.org/schema/beans
  http://www.springframework.org/schema/beans/spring-beans.xsd">
  <reference id="personDao" interface="org.springbyexample.sdms.simpleForm.orm.dao.PersonDao"/>
</beans:beans>
```
This standard Spring MVC configuration file scans for controller classes, creates handlers, configures Tiles, and also internationalization. The `classnameControllerMappings` bean enables convention based mappings for reduced configuration. It is configured to be case sensitive, so a controller called `StudentPersonController` would map to the URL '/studentPerson'. Although it defaults to case insensitive and would then map to the URL '/studentperson'. The default handler is set with the `UrlFilenameViewController`, which will handle any requests not handled by a convention based controller.

```
src/main/resources/META-INF/spring/webmvc-context.xml
```

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:p="http://www.springframework.org/schema/p"
    xmlns:context="http://www.springframework.org/schema/context"
    xsi:schemaLocation="http://www.springframework.org/schema/beans
    http://www.springframework.org/schema/beans/spring-beans.xsd
    http://www.springframework.org/schema/context
    http://www.springframework.org/schema/context/spring-context.xsd">
    <context:component-scan base-package="org.springbyexample.sdms.simpleForm.web.mvc" />
    <!-- Enables /[resource]/[action] to [Resource]Controller class mapping -->
    <bean id="classnameControllerMappings"
        class="org.springframework.web.servlet.mvc.support.ControllerClassNameHandlerMapping"
        p:order="1"
        p:interceptors-ref="localeChangeInterceptor"
        p:caseSensitive="true">
        <property name="defaultHandler">
            <bean class="org.springframework.web.servlet.mvc.UrlFilenameViewController" />
        </property>
    </bean>
    <!-- Enables annotated POJO @Controllers -->
    <bean class="org.springframework.web.servlet.mvc.annotation.AnnotationMethodHandlerAdapter" />
    <!-- Enables plain Controllers -->
    <bean class="org.springframework.web.servlet.mvc.SimpleControllerHandlerAdapter" />
    <bean id="tilesConfigurer"
        class="org.springframework.web.servlet.view.tiles2.TilesConfigurer"
        <property name="definitions">
            <list>
                <value>/WEB-INF/tiles-defs/templates.xml</value>
            </list>
            <value>/WEB-INF/tiles-defs/templates.xml</value>
        </property>
    </bean>
    <!-- Declare the Interceptor -->
    <bean id="localeChangeInterceptor"
        class="org.springframework.web.servlet.i18n.LocaleChangeInterceptor"
        p: paramName="locale" />
    <!-- Declare the Resolver -->
```

Spring by Example Version 1.3

Spring by Example

286
JSP Example

A simple person form using Spring's custom JSP tags.

src/main/resources/MODULE-INF/WEB-INF/jsp/person/form.jsp

```jsp
<%@ taglib prefix="c" uri="http://java.sun.com/jsp/jstl/core"%>
<%@ taglib prefix="fmt" uri="http://java.sun.com/jsp/jstl/fmt" %>
<%@ taglib prefix="form" uri="http://www.springframework.org/tags/form"%>

<h1><fmt:message key="person.form.title"/></h1>
<c:if test="${not empty statusMessageKey}">
  <p><fmt:message key="${statusMessageKey}"/></p>
</c:if>
<c:url var="url" value="/person/form.html" />
<form:form action="${url}" commandName="person">
  <form:hidden path="id" />
  <fieldset>
    <div class="form-row">
      <label for="firstName"><fmt:message key="person.form.firstName"/>:</label>
      <span class="input"><form:input path="firstName" /></span>
    </div>
    <div class="form-row">
      <label for="lastName"><fmt:message key="person.form.lastName"/>:</label>
      <span class="input"><form:input path="lastName" /></span>
    </div>
    <div class="form-buttons">
      <div class="button"><input name="submit" type="submit" value="<fmt:message key="button.save"/>" /></div>
    </div>
  </fieldset>
</form:form>
```

This is the search page and next to each record displayed is an 'edit' and 'delete' link.

src/main/resources/MODULE-INF/WEB-INF/jsp/person/search.jsp

```jsp
<%@ taglib prefix="c" uri="http://java.sun.com/jsp/jstl/core"%>
<%@ taglib prefix="fmt" uri="http://java.sun.com/jsp/jstl/fmt" %>
<%@ taglib prefix="form" uri="http://www.springframework.org/tags/form"%>

<h1><fmt:message key="person.search.title"/></h1>
<table class="search">
  <tr>
    <th><fmt:message key="person.form.firstName"/></th>
    <th><fmt:message key="person.form.lastName"/></th>
  </tr>
  <tr>
    <th><fmt:message key="person.form.firstName"/></th>
    <th><fmt:message key="person.form.lastName"/></th>
  </tr>
</table>
```

Simple Spring MVC
Below is an example of an alternative way to handle a delete following a REST style approach, although the following JavaScript won't work in IE. A library like Dojo should be used for the AJAX call to make the JavaScript browser independent.

The delete method in the controller would be made to only accept an HTTP DELETE. A standard HTML form can't submit this type of request, but JavaScript's XMLHttpRequest can. Ideally in a more complex example, Spring JS would be used to decorate the link with JavaScript and there would be a URL that would still function with a standard GET or POST in case the user has JavaScript disabled in their browser.

The delete link calls the JavaScript function deletePerson passing in the URL that should be called by XMLHttpRequest using an HTTP DELETE (instead of the usual GET or POST). Before the delete is processed it is confirmed by a JavaScript popup.

Alternative search JSP

```javascript
//<script language="javascript"> //<!--
function deletePerson(url){
   var confirmed = confirm('<fmt:message key="person.form.confirmDelete"/>');
   if (confirmed) {
      var request = new XMLHttpRequest();
      request.open('DELETE', url, true);
      request.onreadystatechange = function () { window.location.reload(true); };
      request.send(null);
   }
   // -->
</script>
<h1><fmt:message key="person.search.title"/></h1>
```
Code Example

Because of the `controllerMappings` bean, the controller is automatically mapped to handle '/person/*' based on it's name (ex: [Path]Controller). Then the method names are used to match the rest of the path. So, '/person/form' will match the `form` method. The `ModelAttribute` will be called before each path mapped to the controller. For example, when '/person/form' is called, the `newRequest` method will be called first so an instance of `Person` is available to bind to the form.

The search method doesn't currently use the person model attribute from the `newRequest` method, but in a more advanced example it likely would. For example using the first and last name fields to perform a like search in the database.

```
@ModelAttribute
public Person newRequest(@RequestParam(required=false) Integer id) {
    return (id != null ? personDao.findPersonById(id) : new Person());
}
```
* <p>Person form request.</p>
* 
* <p>Expected HTTP GET and request '/person/form'.</p>
* 
@RequestMapping(method=RequestMethod.GET)
public void form() {} 

/**
* <p>Saves a person.</p>
* 
* <p>Expected HTTP POST and request '/person/form'.</p>
* 
@RequestMapping(method=RequestMethod.POST)
public void form(Person person, Model model) {
   if (person.getCreated() == null) {
      person.setCreated(new Date());
   }

   Person result = personDao.save(person);
   // set id from create
   if (person.getId() == null) {
      person.setId(result.getId());
   }

   model.addAttribute("statusMessageKey", "person.form.msg.success");
}

/**
* <p>Deletes a person.</p>
* 
* <p>Expected HTTP POST and request '/person/delete'.</p>
* 
@RequestMapping(method=RequestMethod.POST)
public String delete(Person person) {
   personDao.delete(person);
   return SEARCH_VIEW_KEY;
}

/**
* <p>Searches for all persons and returns them in a
* <code>Collection</code>.</p>
* 
* <p>Expected HTTP GET and request '/person/search'.</p>
* 
@RequestMapping(method=RequestMethod.GET)
public @ModelAttribute(SEARCH_MODEL_KEY) Collection<Person> search() {
   return personDao.findPersons();
}

Example 3 Simple Spring MVC PersonController

5. Reference

Related Links

- OSGi Alliance [http://www.osgi.org/]
• Equinox [http://www.eclipse.org/equinox/]

• Adrian Colyer’s blog ‘Why should I care about OSGi anyway?’ [http://blog.springsource.com/2008/05/15/why-should-i-care-about-osgi-anyway/]

• Rob Harrop’s blog ‘Getting started with SpringSource dm Server’ [http://blog.springsource.com/2008/10/22/getting-started-with-springsource-dm-server/]

## Project Setup

The project is available to checkout from an anonymous Subversion checkout.

## Command Line Example

This will checkout all four projects, but each one could be checked out individually too.

```
$ svn co http://svn.springbyexample.org/sdms/simple-spring-mvc/tags/1.0.3/ simple-spring-mvc
```

## General Setup Instructions

General instructions for checking out the project with Eclipse and building with Maven.

Example Project Setup

## Project Information

• Spring Framework 2.5.x

• Spring dm Server 1.0
Part VIII. Modules

Reusable libraries/modules released under the Apache License, Version 2.0 [http://www.apache.org/licenses/LICENSE-2.0.txt] and developed with Java 7.
Module Summary

David Winterfeldt
2008

Reusable libraries/modules released under the Apache License, Version 2.0 [http://www.apache.org/licenses/LICENSE-2.0.txt] and developed with Java 7.

1. Downloads

Custom ServletContext Scope Module

The Spring by Example Custom ServletContext Scope module is a custom scope implementation for providing ServletContext (web application) scoped beans.

- Custom ServletContext Scope Module
- Custom ServletContext Scope Module Site [http://springbyexample.org/maven/site/sbe-servlet-context-scope/1.0.3/sbe-servlet-context-scope/]
- Download
- Maven Dependency Instructions or Custom ServletContext Scope Module 1.0.3 JAR [http://springbyexample.org/maven/repo/org/springbyexample/sbe-servlet-context-scope/1.0.3/sbe-servlet-context-scope-1.0.3.jar]

Custom Thread Scope Module

The Spring by Example Custom Thread Scope module is a custom scope implementation for providing thread scoped beans.

Note

See org.springframework.context.support.SimpleThreadScope, which was added in Spring 3.0, for a Spring Framework implementation. Although the Spring version doesn't support destruction callbacks (this implementation does when using a custom Runnable).

- Custom Thread Scope Module
- Custom Thread Scope Module Site [http://springbyexample.org/maven/site/sbe-thread-scope/1.0.3/sbe-thread-scope/]
- Download
- Maven Dependency Instructions or Custom Thread Scope Module 1.0.3 JAR [http://springbyexample.org/maven/repo/org/springbyexample/sbe-thread-scope/1.0.3/sbe-thread-scope-1.0.3.jar]
Dynamic Tiles Module

The Dynamic Tiles 2 module dynamically renders a Tiles 2 template with Spring MVC. Any request coming in mapped for Tiles processing will use the default template and dynamically insert the body based on the URL. There is support for AJAX and Spring Web Flow requests to render a fragment of a URL (based on AjaxTilesView from Spring JS and FlowAjaxTilesView from Spring Web Flow).

- Dynamic Tiles Spring MVC Module
- Download
- Maven Dependency Instructions or Dynamic Tiles Module 1.2.2 JAR

Spring by Example JCR Module

The Spring by Example JCR module uses Spring Modules JCR (Java Content Repository) module. Currently the utilities provide a way to recurse through the repositories nodes using JcrTemplate and a custom node callback for each matching node found while recursing the repository. This example uses Apache Jackrabbit for the Java Content Repository which is the reference implementation for JSR-170.

- Spring by Example JCR Module
- Spring by Example JCR Module Site
- Download
- Maven Dependency Instructions or Spring by Example JCR Module 1.0.3 JAR

Spring by Example Utils Module

The Spring by Example Utils module currently has the HttpClientTemplate and HttpClientOxmTemplate which are light wrappers on top of Apache's HttpClient providing Spring style code based templating. The latter template provides marshaling and unmarshaling of XML based requests.

Built on top of the HttpClientTemplate and HttpClientOxmTemplate, the SolrOxmClient provides for easier client communication with Apache Solr [http://lucene.apache.org/solr/]. Solr [http://lucene.apache.org/solr/] provides an XML based API over HTTP to the Apache Lucene [http://lucene.apache.org/] search engine. SolrOxmClient marshalls/unmarshalls searches and updates to and from a JavaBean. It also allows calls to commit, rollback, and optimize.

The Logger BeanPostProcessor provides logger creation and injection based on reflection, interfaces, or annotations.

The ImageProcessor [http://springbyexample.org/maven/site/sbe-util/1.2.4/sbe-util/apidocs/org/springbyexample/util/image/ImageProcessor.html] is a utility to process images and currently can help scale and image from one size to another either using a

- Spring by Example Utils Module
- Spring by Example Utils Module Site [http://springbyexample.org/maven/site/sbe-util/1.2.4/sbe-util/]
- Download
  - Maven Dependency Instructions or Spring by Example Utils 1.2.4 Module JAR [http://springbyexample.org/maven/repo/org/springbyexample/sbe-util/1.2.4/sbe-util-1.2.4.jar]

**Spring by Example Web Module**

There is a Spring GWT Controller for standard GWT usage and also Spring Bayeux integration for using Comet on Jetty.

There is an `ImageInterceptor` that intercepts a request and looks in a directory that matches the requests relative path. Currently it only matches one image extension type which defaults to `.jpg`. It generates a thumbnail if one doesn't exist and also makes a list of available thumbnails and images.

- Spring by Example Web Module
- Spring by Example Web Module Site [http://springbyexample.org/maven/site/sbe-web/1.1.4/sbe-web/]
- Download
  - Maven Dependency Instructions or Spring by Example Web Module 1.1.4 JAR [http://springbyexample.org/maven/repo/org/springbyexample/sbe-web/1.1.4/sbe-web-1.1.4.jar]
The Spring by Example Custom ServletContext Scope module is a custom scope implementation for providing ServletContext (web application) scoped beans.

It can be useful for sharing a Spring bean between web applications if your servlet container has cross context support. Tomcat has cross context support that can be turned on by setting crossContext="true" on the Context. See Tomcat's context documentation for more details.

**Note**

Even though a bean can be shared between web contexts, only classes loaded by a parent classloader can be shared. The easiest thing to do is either share data as XML or in a Map or String (something JVM's core). Then there won't be any ClassCastException. Or the server can be configured to have the shared class in the parent classloader. For example, in Tomcat the jar with the shared class could be put in Tomcat's lib directory, but this should be avoided as much as possible since it will cause your web applications to be tightly coupled together.

### 1. Spring Configuration

The custom ServletContextScope is registered with the CustomScopeConfigurer under the key 'servletContext'. The key can be used to specify the scope on a bean just like the default scopes 'singleton' or 'prototype'.

```xml
<bean class="org.springframework.beans.factory.config.CustomScopeConfigurer">
  <property name="scopes">
    <map>
      <entry key="servletContext">
        <bean class="org.springbyexample.web.context.ServletContextScope"/>
      </entry>
    </map>
  </property>
</bean>
```

This is the same, but it specifies a specific context to use for storing and retrieving values.

```xml
<bean class="org.springframework.beans.factory.config.CustomScopeConfigurer">
</bean>
```
2. Download

If you are using Maven, you can use the Maven dependency below and add a repository definition for the Spring by Example Maven repository. Otherwise you can download the jar directly from the Spring by Example Maven repository (http://www.springbyexample.org/maven/repo/).

```
<dependency>
  <groupId>org.springbyexample</groupId>
  <artifactId>sbe-servlet-context-scope</artifactId>
  <version>1.0.3</version>
</dependency>
```

```
<repositories>
  <repository>
    <id>springbyexample.org</id>
    <name>Spring by Example</name>
    <url>http://www.springbyexample.org/maven/repo</url>
  </repository>
</repositories>
```

3. Reference

Related Links

- Custom **ServletContext** Scope Site
  [http://springbyexample.org/maven/site/sbe-servlet-context-scope/1.0.3/sbe-servlet-context-scope/]

- Spring 3.2.x Custom Scopes Documentation
  [http://static.springsource.org/spring/docs/3.2.x/spring-framework-reference/html/beans.html#beans-factory-scopes-custom]

Project Setup

Follow the Project Checkout instructions for git, then go to the project (relative path below).
General Setup Instructions

General instructions for checking out the project with Eclipse and building with Maven.

Example Project Setup

Project Information

• Spring Framework 3.2.x
The Custom Thread Scope module is a custom scope implementation for providing thread scoped beans. Every request for a bean will return the same instance for the same thread. A Runnable must be wrapped in a ThreadScopeRunnable if destruction callbacks should occur on a thread scoped bean.

Note
See SimpleThreadScope [http://static.springsource.org/spring/docs/3.2.x/javadoc-api/org/springframework/context/support/SimpleThreadScope.html], which was added in Spring 3.0, for a Spring Framework implementation Although the Spring version doesn’t support destruction callbacks (this implementation does when using a custom Runnable).

1. Spring Configuration

The threadCounter bean is set to use the custom ThreadScope and the CustomScopeConfigurer registers the custom scope.

```xml
<bean id="threadCounter"
     class="org.springbyexample.bean.scope.thread.Counter"
     scope="thread" />

<bean class="org.springframework.beans.factory.config.CustomScopeConfigurer">
    <property name="scopes">
        <map>
            <entry key="thread">
                <bean class="org.springbyexample.bean.scope.thread.ThreadScope"/>
            </entry>
        </map>
    </property>
</bean>
```

2. Code Example

Below is the code for the ThreadScopeRunnable class. It can be used to wrap another Runnable so when it's finished running it clears the current thread scoped variables in order for destruction callbacks to run. There is also a ThreadScopeCallable class for wrapping a Callable. If you have your own custom Thread implementations, they can call ThreadScopeContextHolder.currentThreadScopeAttributes().clear() directly.
public class ThreadScopeRunnable implements Runnable {
    protected Runnable target = null;

    /**
     * Constructor
     */
    public ThreadScopeRunnable(Runnable target) {
        this.target = target;
    }

    /**
     * Runs <code>Runnable</code> target and
     * then afterword processes thread scope
     * destruction callbacks.
     */
    public final void run() {
        try {
            target.run();
        } finally {
            ThreadScopeContextHolder.currentThreadScopeAttributes().clear();
        }
    }
}

3. Download

If you are using Maven, you can use the Maven dependency below and add a repository definition for the Spring by Example Maven repository. Otherwise you can download the jar directly from the Spring by Example Maven repository (http://www.springbyexample.org/maven/repo/).

<dependency>
  <groupId>org.springbyexample</groupId>
  <artifactId>sbe-thread-scope</artifactId>
  <version>1.0.3</version>
</dependency>

<repositories>
  <repository>
    <id>springbyexample.org</id>
    <name>Spring by Example</name>
    <url>http://www.springbyexample.org/maven/repo</url>
  </repository>
</repositories>

4. Reference
Related Links

- Custom Thread Scope Site [http://springbyexample.org/maven/site/sbe-thread-scope/1.0.3/sbe-thread-scope/]
- Spring 3.2.x Custom Scopes Documentation [http://static.springsource.org/spring/docs/3.2.x/spring-framework-reference/html/beans.html#beans-factory-scopes-custom]
- Spring JIRA 2581 - Provide out of the box implementation of the thread scope [http://jira.springframework.org/browse/SPR-2581]

Project Setup

Follow the Project Checkout instructions for git, then go to the project (relative path below).

```bash
$ cd modules/sbe-thread-scope
```

General Setup Instructions

General instructions for checking out the project with Eclipse and building with Maven.

Example Project Setup

Project Information

- Spring Framework 3.2.x
Spring by Example's Dynamic Tiles 2
Spring MVC Module

David Winterfeldt
2008

The Dynamic Tiles 2 Spring MVC Module [http://springbyexample.org/maven/site/sbe-dynamic-tiles2/1.2.2/sbe-dynamic-tiles2/], version 1.2, dynamically renders a Tiles 2 [http://tiles.apache.org/] template with Spring MVC. Any request coming in mapped for Tiles processing will use the default template and dynamically insert the body based on the URL.

Besides basic support for rendering dynamically rendering Tiles templates, there is also support for rendering Tiles fragments like AjaxTilesView and FlowAjaxTilesView in Spring JS and Spring Web Flow

1. Spring Configuration

The tilesConfigurer bean initializes tiles with all the tiles configuration files (more than one can be specified). The tilesViewResolver bean defines using DynamicTilesView which uses the url to lookup the Tiles definition, dynamically insert the body into the definition, and render it.

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  <bean id="tilesConfigurer" class="org.springframework.web.servlet.view.tiles2.TilesConfigurer">
    <property name="definitions">
      <list>
        <value>/WEB-INF/tiles-defs/templates.xml</value>
      </list>
    </property>
  </bean>
  <bean id="tilesViewResolver" class="org.springframework.web.servlet.view.UrlBasedViewResolver">
    <property name="viewClass" value="org.springbyexample.web.servlet.view.tiles2.DynamicTilesView"/>
    <property name="prefix" value="/WEB-INF/jsp/"/>
    <property name="suffix" value=".jsp"/>
  </bean>
  <bean id="urlMapping" class="org.springframework.web.servlet.handler.SimpleUrlHandlerMapping">
    <property name="mappings">
      <props>
        <prop key="/**/html">viewController</prop>
      </props>
    </property>
  </bean>
  <bean id="viewController" class="org.springframework.web.servlet.mvc.UrlFilenameViewController"/>
</beans>
```
For the AJAX requests to work correctly an `AjaxUrlBasedViewResolver` must be configured and `FlowAjaxDynamicTilesView` as the view class.

```xml
<bean id="tilesViewResolver"  
   class="org.springframework.js.ajax.AjaxUrlBasedViewResolver">  
   <property name="viewClass"  
   value="org.springbyexample.web.servlet.view.tiles2.FlowAjaxDynamicTilesView" />  
   <property name="prefix" value="/WEB-INF/jsp/" />  
   <property name="suffix" value=".jsp" />  
</bean>
```

2. Tiles XML Configuration

The Tiles `.mainTemplate` sets up the default layout. Each page is dynamically rendered by dynamically setting the body on the derived Tiles definition. Which in this case is `.mainTemplate`.

```xml
<?xml version="1.0" encoding="ISO-8859-1" ?>  
<!DOCTYPE tiles-definitions PUBLIC  
"-//Apache Software Foundation//DTD Tiles Configuration 2.0//EN"  
"http://tiles.apache.org/dtds/tiles-config_2_0.dtd">  
<tiles-definitions>  
<!-- Default Main Template -->  
<definition name=".mainTemplate" template="/WEB-INF/templates/main.jsp">  
   <put-attribute name="title" value="Simple Tiles 2 Example" type="string" />  
   <put-attribute name="header" value="/WEB-INF/templates/header.jsp" />  
   <put-attribute name="footer" value="/WEB-INF/templates/footer.jsp" />  
   <put-attribute name="menu" value="/WEB-INF/templates/menu.jsp" />  
   <put-attribute name="content" value="/WEB-INF/templates/blank.jsp" />  
</definition>  
</tiles-definitions>
```

3. Tiles JSP Example

This JSP has the main layout for where the header, footer, menu, and body are located. They are inserted using Tiles custom JSP tags.
4. DynamicTilesView

Processing Order

If a request is made for '/info/index.html', Spring will pass 'info/index' into the view. The first thing will be to look for 'info/index' as a Tiles definition. Then a template definition of '.info.mainTemplate', which if found will dynamically have a body set on this definition. If the previous aren't found, it is assumed a root definition exists. This would be '.mainTemplate'. If none of these exist, a TilesException will be thrown.

1. Check if a Tiles definition based on the URL matches.

2. Checks if a definition derived from the URL and default template name exists and then dynamically insert the body based on the URL.

3. Check if there is a root template definition and then dynamically insert the body based on the URL.

4. If no match is found from any process above a TilesException is thrown.

The following are the default values for determining a Tiles definition for a request. If these aren't acceptable, they can be changed using TilesUrlBasedViewResolver which is a subclass of UrlBasedViewResolver. Or for AJAX support TilesAjaxUrlBasedViewResolver, which is a subclass of AjaxUrlBasedViewResolver, can be used.

Table 1. DynamicTilesView Defaults

<table>
<thead>
<tr>
<th>Property</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>tilesDefinitionName</td>
<td>mainTemplate</td>
</tr>
</tbody>
</table>
5. Download

If you are using Maven, you can use the Maven dependency below and add a repository definition for the Spring by Example Maven repository. Otherwise you can download the jar directly from the Spring by Example Maven repository (http://www.springbyexample.org/maven/repo/).

```
<dependency>
    <groupId>org.springbyexample</groupId>
    <artifactId>sbe-dynamic-tiles2</artifactId>
    <version>1.2.2</version>
</dependency>
<repositories>
    <repository>
        <id>springbyexample.org</id>
        <name>Spring by Example</name>
        <url>http://www.springbyexample.org/maven/repo</url>
    </repository>
</repositories>
```

6. Reference

Related Links

- Dynamic Tiles 2 Site [http://springbyexample.org/maven/site/sbe-dynamic-tiles2/1.2.2/sbe-dynamic-tiles2/]
- Spring 3.2.x Tiles Documentation
Tiles 2 [http://tiles.apache.org/]

Project Setup

Follow the Project Checkout instructions for git, then go to the project (relative path below).

```
$ cd modules/sbe-dynamic-tiles2
```

Dynamic Tiles 2 Webapp Example

```
$ svn co http://svn.springbyexample.org/web/dynamic-tiles2-webapp/tags/1.2/ dynamic-tiles2-webapp
```

General Setup Instructions

General instructions for checking out the project with Eclipse and building with Maven.

Example Project Setup

Project Information

- Spring Framework 3.2.x
- Tiles 2
Spring by Example JCR Module

David Winterfeldt

2008

The Spring by Example JCR module uses Spring Modules JCR (Java Content Repository) module. Currently the utilities provide a way to recurse through the repositories nodes using JcrTemplate and a custom node callback for each matching node found while recursing the repository. This example uses Apache Jackrabbit for the Java Content Repository which is the reference implementation for JSR-170.

1. Spring Configuration

The first bean definition defines defines the Jackrabbit repository by specifying the configuration file to use and the location of the repository. If the repository doesn't already exist, it will be created on startup. The next bean creates a session factory based on the repository and the next one creates a JcrTemplate using the session factory.

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xmlns:context="http://www.springframework.org/schema/context"
      xsi:schemaLocation="http://www.springframework.org/schema/beans
                      http://www.springframework.org/schema/beans/spring-beans.xsd
                      http://www.springframework.org/schema/context
                      http://www.springframework.org/schema/context/spring-context.xsd">
  <!-- Register Annotation-based Post Processing Beans -->
  <context:annotation-config />

  <!-- Scan context package for any eligible annotation configured beans. -->
  <context:component-scan base-package="org.springbyexample.jcr" /> 

  <!-- normal repository -->
  <bean id="repository" class="org.springmodules.jcr.jackrabbit.RepositoryFactoryBean">
    <!-- normal factory beans params -->
    <property name="configuration" value="classpath:/jackrabbit-repository.xml" />
    <property name="homeDir" value="file:./target/repo" />
  </bean>

  <bean id="sessionFactory" class="org.springmodules.jcr.jackrabbit.JackrabbitSessionFactory">
    <property name="repository" ref="repository" />
  </bean>

  <bean id="jcrTemplate" class="org.springmodules.jcr.JcrTemplate">
    <property name="sessionFactory" ref="sessionFactory" />
    <property name="allowCreate" value="true" />
  </bean>

  <bean id="processor" class="org.springbyexample.jcr.JcrContentExporter">
    <property name="contentRecurser" ref="jcrContentRecurser" />
    <property name="rootFolder" value="./target/repo_export" />
  </bean>

</beans>
```
2. Code Example

The example shows calling JcrContentExporter which is defined in the Spring configuration. It just needs a reference to the JcrContentRecurser, which is automatically loaded by the context:component-scan since it has an @Component annotation, and also a file path where to export all content nodes in the repository.

This is an excerpt from JcrContentExporterIT.

```java
@Autowired
private JcrContentExporter processor = null;
...
public void testJcrContentProcessor() {
  ...
  List<String> lResults = processor.process();
  ...
}
```

**Example 1 Content Exporter**

This example is from JcrContentExporter. It processes each content node and writes the content to an export directory, but obviously any type of processing can be done on the content node inside the callback.

For every content node found while recursing the repository JcrNodeCallback.doInJcrNode(Session session, Node node) is called. The file name and relative path from the root node is derived and then the content is retrieved and written to the export directory.

```java
public List<String> process() {
  final List<String> lResults = new ArrayList<String>();
  contentRecurser.recurse(new JcrNodeCallback() {
    public void doInJcrNode(Session session, Node node)
      throws IOException, RepositoryException {
      // file name node is above content
      String fileName = node.getParent().getName();
      // file path is two above content
      String path = node.getParent().getParent().getPath();
      logger.debug("In content recurser callback.\n      * fileName='{}' path='{}'", fileName, path);
      File fileDir = new File(rootFolder + path);
      File file = new File(fileDir, fileName);
      Property dataProperty = node.getProperty(JcrConstants.JCR_DATA);
      InputStream in = null;
      OutputStream out = null;
      try {
        FileUtils.forceMkdir(fileDir);
        in = dataProperty.getStream();
        out = new FileOutputStream(file);
        ...
      }
    }
  });
  lResults.addAll(processor.process());
  return lResults;
}
```
Example 2 Using JcrContentRecurser

The previous example of JcrContentRecurser is a very simple subclass of JcrRecurser. If it no specific node matching is set on it, it’s callback will be called for every node in the repository. But a Set of specific node names to match can be passed in either through the constructor or methods.

Below is JcrContentRecurser which just sets the content node as the only node to have callbacks performed.

```java
public class JcrContentRecurser extends JcrRecurser {
    final Logger logger = LoggerFactory.getLogger(JcrContentRecurser.class);

    /**
     * Constructor
     */
    public JcrContentRecurser() {
        super(JcrConstants.JCR_CONTENT);
    }
}
```

Example 3 Using JcrRecurser

3. Download

If you are using Maven, you can use the Maven dependency below and add a repository definition for the Spring by Example Maven repository. Otherwise you can download the jar directly from the Spring by Example Maven repository (http://www.springbyexample.org/maven/repo/).

```xml
<dependency>
    <groupId>org.springbyexample</groupId>
    <artifactId>sbe-jcr</artifactId>
    <version>1.0.3</version>
</dependency>

<repositories>
    <repository>
        <id>springbyexample.org</id>
        <repositoryId>springbyexample.org</repositoryId>
    </repository>
</repositories>
```
4. Reference

Related Links

- Spring by Example JCR Site [http://springbyexample.org/maven/site/sbe-jcr/1.0.3/sbe-jcr/]
- Spring Modules [http://www.springsource.org/spring-modules]
- Apache Jackrabbit [http://jackrabbit.apache.org/]
- Integrating Java Content Repository and Spring [http://www.infoq.com/articles/spring-modules-jcr]

Project Setup

Follow the Project Checkout instructions for git, then go to the project (relative path below).

```
$ cd modules/sbe-jcr
```

General Setup Instructions

General instructions for checking out the project with Eclipse and building with Maven.

Example Project Setup

Project Information

- Spring Framework 3.2.x
The Spring by Example Utils module currently has the HttpClientTemplate and HttpClientOxmTemplate which are light wrappers on top of Apache's HttpClient providing Spring style code based templating. The latter template provides marshaling and unmarshalling of XML based requests.

The Logger BeanPostProcessor provides logger creation and injection based on reflection, interfaces, or annotations.

The ImageProcessor [http://springbyexample.org/maven/site/sbe-util/1.2.4/sbe-util/apidocs/org/springbyexample/util/image/ImageProcessor.html] is a utility to process images and currently can help scale and image from one size to another either using a java.io.File or a java.io.InputStream to a java.io.OutputStream.

1. HttpClientTemplate

HttpClientTemplate which uses Apache's HttpClient to process HTTP requests and receive the data as a String, InputStream, or byte[].

Spring Configuration

Basic Configuration

Set a default URI for the HttpClientTemplate.

```
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xsi:schemaLocation="http://www.springframework.org/schema/beans
                         http://www.springframework.org/schema/beans/spring-beans.xsd">
  <bean id="httpClient" class="org.springbyexample.httpclient.HttpClientTemplate">
    <property name="defaultUri">
      <value><![CDATA[http://localhost:8093/test]]></value>
    </property>
  </bean>
</beans>
```

HTTP Authorization Configuration
The HttpClient instance used by HttpClientTemplate could be set during configuration with authorization, but all of the default authorization classes must be set using constructors. The Spring by Example authorization beans allow the use of setters so are a little more Spring friendly. The example below will use the userName and password when challenged for authentication by a request to localhost:8093.

When accessing a site that will challenge any request, authenticationPreemptive can be set to true. Then the credentials will be sent along with every request instead of a challenging needed to be issues before the credentials are sent.

**HttpClientTemplateAuthTest-context.xml**

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.springframework.org/schema/beans
http://www.springframework.org/schema/beans/spring-beans.xsd">
  <bean id="httpClient" class="org.springbyexample.httpclient.HttpClientTemplate">
    <property name="defaultUri">
      <value><![CDATA[http://localhost:8093/admin/test]]></value>
    </property>
    <property name="credentials">
      <list>
        <bean class="org.springbyexample.httpclient.auth.Credentials">
          <property name="authScopeHost" value="localhost" />
          <property name="authScopePort" value="8093" />
          <property name="userName" value="jsmith" />
          <property name="password" value="password" />
        </bean>
      </list>
    </property>
  </bean>
</beans>
```

**Code Example**

Excerpts from HttpClientTemplateTest.

```java
template.executeGetMethod(new ResponseStringCallback() {
    public void doWithResponse(String response) throws IOException {
        ... 
        logger.debug("HTTP Get string response. '{}",
                           response);
    }
});
```

**Example 1 HTTP Get Response with a String**

```java
template.executeGetMethod(new ResponseStreamCallback() {
});
```
public void doWithResponse(InputStream in) throws IOException {
    String response = IOUtils.toString(in);
    ...
    logger.debug("HTTP Get stream response. '{}'", response);
}

Example 2 HTTP Get Response with an InputStream

template.executeGetMethod(new ResponseByteCallback() {
    public void doWithResponse(byte[] byteResponse) throws IOException {
        String response = new String(byteResponse);
        ...
        logger.debug("HTTP Get byte response. '{}'", response);
    }
});

Example 3 HTTP Get Response with a Byte Array

Map<String, String> hParams = new HashMap<String, String>();
hParams.put(GET_PARAM_INPUT_KEY, GET_PARAM_INPUT_VALUE);

Map<String, String> hParams = new HashMap<String, String>();
template.executeGetMethod(hParams,
        new ResponseStringCallback() {
            public void doWithResponse(String response) throws IOException {
                ...
                logger.debug("HTTP Get with params string response. '{}'", response);
            }
        });

Example 4 HTTP Get with Parameters & Response with a String

Map<String, String> hParams = new HashMap<String, String>();
hParams.put(LOWER_PARAM, POST_NAME);

Map<String, String> hParams = new HashMap<String, String>();
template.executePostMethod(hParams,
        new ResponseStringCallback() {
            public void doWithResponse(String response) throws IOException {
                ...
                logger.debug("HTTP Post string response. '{}'", response);
            }
        });
Example 5 HTTP Post with Parameters & Response with a String

```java
Map<String, String> hParams = new HashMap<String, String>();
hParams.put(LOWER_PARAM, POST_NAME);

template.executePostMethod(hParams,
    new ResponseStreamCallback() {
        public void doWithResponse(InputStream in) throws IOException {
            String response = IOUtils.toString(in);
            ...
            logger.debug("HTTP Post stream response. '{}'", response);
        }
    });
```

Example 6 HTTP Post with Parameters & Response with an InputStream

```java
Map<String, String> hParams = new HashMap<String, String>();
hParams.put(LOWER_PARAM, POST_NAME);

template.executePostMethod(hParams,
    new ResponseByteCallback() {
        public void doWithResponse(byte[] byteResponse) throws IOException {
            String response = new String(byteResponse);
            ...
            logger.debug("HTTP Post byte response. '{}'", response);
        }
    });
```

Example 7 HTTP Post with Parameters & Response with a Byte Array

A post sending data, like XML, in the request for the server to process and return results.

```java
protected final static String POST_DATA_INPUT = "<message>Greetings</message>";
...

template.executePostMethod(POST_DATA_INPUT,
    new ResponseStringCallback() {
        public void doWithResponse(String response) throws IOException {
            ...
            logger.debug("HTTP string data post string response. '{}'", response);
        }
    });
```

Example 8 HTTP Post with Data & Response with a String
2. HttpClientOxmTemplate

HttpClientOxmTemplate which uses Apache's HttpClient [http://hc.apache.org/] to process HTTP requests and Spring Web Service's OXM [http://static.springframework.org/spring-ws/site] to marshall and unmarshall the requests.

Spring Configuration

Define a marshaller/unmarshaller and set it on HttpClientOxmTemplate along with it's default URI.

HttpClientOxmTemplateTest-context.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xsi:schemaLocation="http://www.springframework.org/schema/beans
      http://www.springframework.org/schema/beans/spring-beans.xsd">
  <bean id="jaxbMarshaller" class="org.springframework.oxm.jaxb.Jaxb2Marshaller">
    <property name="contextPath" value="org.springbyexample.schema.beans"/>
  </bean>
  <bean id="httpClient" class="org.springbyexample.httpclient.HttpClientOxmTemplate">
    <property name="defaultUri">
      <value>http://localhost:8093/test</value>
    </property>
    <property name="marshaller" ref="jaxbMarshaller"/>
    <property name="unmarshaller" ref="jaxbMarshaller"/>
  </bean>
</beans>
```

Code Example

The instance of Persons is marshalled and the XML is posted to the default uri and the callback has the XML result unmarshalled back to an instance of Persons. The class passed in and returned in this example match, but they don't need to since a different marshaller and unmarshaller can be used.

```java
template.executePostMethod(persons, new ResponseCallback<Persons>() {
    public void doWithResponse(Persons persons) throws IOException {
      ...
      Person result = persons.getPerson().get(0);
      ...
      logger.debug("id={} firstName={} lastName={}",
                  new Object[] { result.getId(),
                                result.getFirstName(),
                                result.getLastName()});
    }
  });
```
3. SolrOxmClient

The SolrOxmClient provides for easier client communication with Apache Solr [http://lucene.apache.org/solr/]. It marshalls/unmarshalls searches and updates to and from a JavaBean. It also allows calls to commit, rollback, and optimize. It is built on top of HttpClientTemplate and HttpClientOxmTemplate.

Note

The Spring configuration and code are from the Solr Client example and are not part of this module.

Spring Configuration

A base URL to Solr [http://lucene.apache.org/solr/] and a marshaller and unmarshaller must be defined to use it. To read more about the test look at the Solr Client example.

HttpClientOxmTemplateTest-context.xml

```xml
<bean id="solrOxmClient" class="org.springbyexample.httpclient.solr.SolrOxmClient"
    p:baseUrl="http://${solr.host}:${solr.port}/solr"
    p:marshaller-ref="catalogItemMarshaller"
    p:unmarshaller-ref="catalogItemMarshaller" />
```

Code Example

Any Solr [http://lucene.apache.org/solr/] search parameter can be passed in and the results are unmarshalled into a specific JavaBean.

```java
List<CatalogItem> lCatalogItems = client.search(SEARCH_QUERY_PARAM);
```

Example 10 Excerpt from SolrOxmClientIT.testSearch()
Example 11 Excerpt from SolrOxmClientIT.testPaginatedSearch()

Updates a list of CatalogItem instances.

```java
client.update(lCatalogItems);
```

Example 12 Excerpt from SolrOxmClientIT.testUpdate()

4. Logger BeanPostProcessor

There are different logger BeanPostProcessors to dynamically inject a logger based on reflection, interfaces, or annotations. Many loggers are defined with a static reference to the a class for each class and a developer cuts & pastes each logger definition. This can be error prone and the Logger BeanPostProcessors help deal with this problem.

Spring Configuration

All of the logger BeanPostProcessors will ignore any logger that isn't defined in the Map of logger factories. The defaults defined are SLF4J, Apache Commons Logging, Log4J, and JDK Logging. A custom list can be set using the loggerFactoryMap property.

<table>
<thead>
<tr>
<th>Logger</th>
<th>Logger Factory Static Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>org.slf4j.Logger</td>
<td>org.slf4j.LoggerFactory.getLogger</td>
</tr>
<tr>
<td>org.apache.commons.logging.Log</td>
<td>org.apache.commons.logging.LogFactory.getLog</td>
</tr>
<tr>
<td>org.apache.log4j.Logger</td>
<td>org.apache.log4j.Logger.getLogger</td>
</tr>
<tr>
<td>java.util.logging.Logger</td>
<td>java.util.logging.Logger.getLogger</td>
</tr>
</tbody>
</table>

The LoggerBeanPostProcessor uses reflection to set a logger on any method that matches the specified method and the logger being set on it matches the defined loggers and logger factories.

Reflection

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
```

Spring by Example Version 1.3
The LoggerAwareBeanPostProcessor only sets subclasses of the LoggerAware interface. The current interfaces areSlf4JLoggerAware, CommonsLoggerAware, Log4JLoggerAware, andJdkLoggerAware.

Interfaces

The AnnotationLoggerBeanPostProcessor can be used to inject loggers into fields and methods that have theAutoWiredLogger annotation.

Annotations
Code Example

Examples of the beans having loggers inject by the BeanPostProcessors defined in the Spring configurations above.

```java
public class LoggerBean {
    Logger logger = null;

    /**
     * Gets SLF4J logger.
     */
    public Logger getCustomLogger() {
        return logger;
    }

    /**
     * Sets SLF4J logger.
     */
    public void setCustomLogger(Logger logger) {
        this.logger = logger;
    }
}
```

**Example 13 Reflection**

```java
public class Slf4JLoggerBean implements Slf4JLoggerAware {
    Logger logger = null;

    /**
     * Gets SLF4J logger.
     */
    public Logger getLogger() {
        return logger;
    }

    /**
     * Sets SLF4J logger.
     */
    public void setLogger(Logger logger) {
        this.logger = logger;
    }
}
```

**Example 14 Interfaces**

```java
@AutowiredLogger
final Logger logger = null;
```
@AutowiredLogger
def setMethodLogger(Logger methodLogger):
    self.methodLogger = methodLogger

Example 15 Annotations

5. Download

If you are using Maven, you can use the Maven dependency below and add a repository definition for the Spring by Example Maven repository. Otherwise you can download the jar directly from the Spring by Example Maven repository (http://www.springbyexample.org/maven/repo/).

```xml
<dependency>
    <groupId>org.springbyexample</groupId>
    <artifactId>sbe-util</artifactId>
    <version>1.2.4</version>
</dependency>
<repositories>
    <repository>
        <id>springbyexample.org</id>
        <name>Spring by Example</name>
        <url>http://www.springbyexample.org/maven/repo</url>
    </repository>
</repositories>
```

6. Reference

Related Links

- Spring by Example Utils Site [http://springbyexample.org/maven/site/sbe-util/1.2.4/sbe-util/]
- Apache's HttpClient [http://hc.apache.org/]
- Solr Client

Project Setup

Follow the Project Checkout instructions for git, then go to the project (relative path below).

```bash
$ cd modules/sbe-util
```
General Setup Instructions

General instructions for checking out the project with Eclipse and building with Maven.

Example Project Setup

Project Information

- Spring Framework 3.2.x
- Apache Commons HttpClient 3.1
There is a Spring GWT Controller for standard GWT usage and also Spring Bayeux integration for using Comet on Jetty.

There is an `ImageInterceptor` that intercepts a request and looks in a directory that matches the requests relative path. Currently it only matches one image extension type which defaults to '.jpg'. It generates a thumbnail if one doesn't exist and also makes a list of available thumbnails and images.

1. Spring GWT Controller

Spring Configuration

Even though the service controller is annotation-based, since GWT calls RPC methods using reflection, the mapping has to be manually set using the `SimpleUrlHandlerMapping`.

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:context="http://www.springframework.org/schema/context"
    xsi:schemaLocation="http://www.springframework.org/schema/beans
    http://www.springframework.org/schema/beans/spring-beans.xsd
    http://www.springframework.org/schema/context
    http://www.springframework.org/schema/context/spring-context.xsd">
    <context:component-scan base-package="org.springbyexample.web.gwt.server" />
    <bean class="org.springframework.web.servlet.mvc.annotation.DefaultAnnotationHandlerMapping" />
    <bean class="org.springframework.web.servlet.mvc.annotation.AnnotationMethodHandlerAdapter" />
    <bean class="org.springframework.web.servlet.mvc.SimpleControllerHandlerAdapter" />
    <bean class="org.springframework.web.servlet.handler.SimpleUrlHandlerMapping">
        <property name="order" value="0" />
        <property name="mappings">
            <value>/person/service.do=serviceController</value>
        </property>
    </bean>
</beans>
```

Code Example
@Controller
public class ServiceController extends GwtController implements Service {
    final Logger logger = LoggerFactory.getLogger(ServiceController.class);

    private static final long serialVersionUID = -2103209407529882816L;

    @Autowired
    private PersonDao personDao = null;

    /**
     * Finds person within a range.
     */
    public Person[] findPersons(int startIndex, int maxResults) {
        Person[] results = null;
        List<Person> lResults = new ArrayList<Person>();
        Collection<org.springframework.orm.hibernate3.annotation.bean.Person> lPersons =
            personDao.findPersons(startIndex, maxResults);
        for (org.springframework.orm.hibernate3.annotation.bean.Person person : lPersons) {
            Person result = new Person();
            result.setId(person.getId());
            result.setFirstName(person.getFirstName());
            result.setLastName(person.getLastName());
            lResults.add(result);
        }
        return lResults.toArray(new Person[]{});
    }
}

2. Spring Bayeux Integration for Comet on Jetty

Web Configuration

The SpringContinuationCometdServlet is configured to handle all Comet requests. It only needs the asyncDeliver value set on it and the other values you would normally set on ContinuationCometdServlet are all set on SpringContinuationBayeux in the Spring configuration.

```xml
<?xml version="1.0" encoding="ISO-8859-1"?>
<web-app xmlns="http://java.sun.com/xml/ns/javae"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://java.sun.com/xml/ns/javaee
                        http://java.sun.com/xml/ns/javaee/web-app_2_5.xsd"
    version="2.5">
    <display-name>Spring Cometd Test WebApp</display-name>
</web-app>
```
<context-param>
  <param-name>contextConfigLocation</param-name>
  <param-value>/WEB-INF/web-application-context.xml</param-value>
</context-param>

<listener>
  <listener-class>org.springframework.web.context.ContextLoaderListener</listener-class>
</listener>

<servlet>
  <servlet-name>cometd</servlet-name>
  <servlet-class>org.springbyexample.cometd.continuation.SpringContinuationCometdServlet</servlet-class>
  <init-param>
    <param-name>asyncDeliver</param-name>
    <param-value>false</param-value>
  </init-param>
  <load-on-startup>1</load-on-startup>
</servlet>

<servlet-mapping>
  <servlet-name>cometd</servlet-name>
  <url-pattern>/cometd/*</url-pattern>
</servlet-mapping>
</web-app>

---

Spring Configuration

```
[{
  "channels": "/**",
  "filter" : "org.mortbay.cometd.filter.NoMarkupFilter",
  "init" : {}},
{
  "channels": "/chat/**",
  "filter" : "org.mortbay.cometd.filter.RegexFilter",
  "init" : [
    ["Ss[pring] Bb[y] Ee]xample","Spring by Example" ],
    ["Ss][Bb][Ee]","Spring by Example" ]
},
{
  "channels": "/chat/**",
  "filter" : "org.mortbay.cometd.filter.RegexFilter",
  "init" : [
    ["teh ","the "],
    ["sring ","spring "]
  ]
}]
```
**Code Example**

The only difference in this compared to a standard BayeuxService is that this Bayeux implementation is instantiated by Spring and the Bayeux instance is injected into it's constructor.

```java
@Component
public class ChatService extends BayeuxService {
    final Logger logger = LoggerFactory.getLogger(ChatService.class);

    final ConcurrentMap<String, Set<String>> _members = new ConcurrentHashMap<String, Set<String>>();

    /**
     * Constructor
     */
    @Autowired
    public ChatService(Bayeux bayeux) {
        super(bayeux, "chat");
        subscribe("/chat/**", "trackMembers");
    }

    /**
     * Tracks chat clients.
     */
    public void trackMembers(Client joiner, String channel, Map<String, Object> data, String id) {
        if (Boolean.TRUE.equals(data.get("join"))) {
            Set<String> m = _members.get(channel);
            if (m == null) {
                Set<String> new_list = new CopyOnWriteArraySet<String>();
                m = _members.putIfAbsent(channel, new_list);
                if (m == null) {
                    m = new_list;
                }
            }
            final Set<String> members = m;
            final String username = (String) data.get("user");
            members.add(username);
            joiner.addListener(new RemoveListener() {
                public void removed(String clientId, boolean timeout) {
                    members.remove(username);
                    logger.info("members: " + members);
                }
            });
            logger.info("Members: " + members);
            send(joiner, channel, members, id);
        }
    }
}
```

### 3. Image Interceptor
Used for generic thumbnail processing. If a request for '/pics/newyork.html' is received, the image interceptor will look for a directory at '/var/www/html/images/newyork'. If the directory exists generate any missing thumbnails and have the view rendered by the `imageViewName` property.

### Spring Configuration

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
     xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
     xmlns:context="http://www.springframework.org/schema/context"
     xsi:schemaLocation="http://www.springframework.org/schema/beans
     http://www.springframework.org/schema/beans/spring-beans.xsd
     http://www.springframework.org/schema/context
     http://www.springframework.org/schema/context/spring-context.xsd">

  <!-- Setup interceptor for annotation-based controllers -->
  <bean class="org.springframework.web.servlet.mvc.annotation.DefaultAnnotationHandlerMapping">
    <property name="interceptors">
      <list>
        <ref bean="localeChangeInterceptor"/>
        <ref bean="imageInterceptor"/>
      </list>
    </property>
    <property name="defaultHandler">
      <bean class="org.springframework.web.servlet.mvc.UrlFilenameViewController"/>
    </property>
  </bean>

  <bean class="org.springframework.web.servlet.mvc.annotation.AnnotationMethodHandlerAdapter"/>

  <context:annotation-config/>

  <bean id="tilesConfigurer"
       class="org.springframework.web.servlet.view.tiles2.TilesConfigurer">
    <property name="definitions">
      <list>
        <value>/WEB-INF/tiles-defs/templates.xml</value>
      </list>
    </property>
  </bean>

  <bean id="dynamicTilesViewResolver"
       class="org.springframework.web.servlet.view.UrlBasedViewResolver">
    <property name="viewClass" value="org.springframework.web.servlet.view.tiles2.DynamicTilesView" />
    <property name="prefix" value="/WEB-INF/jsp/" />  
    <property name="suffix" value=".jsp" />  
  </bean>

  <bean id="messageSource"
       class="org.springframework.context.support.ResourceBundleMessageSource">
    <property name="basenames">
      <value>messages</value>
    </property>
  </bean>

  <!-- Declare the Interceptor -->
  <bean id="localeChangeInterceptor"
       class="org.springframework.web.servlet.i18n.LocaleChangeInterceptor">
    <property name="paramName" value="locale"/>
  </bean>

  <!-- Declare the Resolver -->
  <bean id="localeResolver" class="org.springframework.web.servlet.i18n.SessionLocaleResolver"/>
</beans>
```
<bean name="imageInterceptor" class="org.springbyexample.web.servlet.image.ImageInterceptor">
  <property name="imageProcessor">
    <bean class="org.springbyexample.util.image.ImageProcessorImpl" />
  </property>
  <property name="rootImagePath" value="/var/www/html" />
  <property name="imageViewName" value="/pics/generic_display" />
</bean>
</beans>

### JSP Example

JSP referenced by the `imageViewName` property defined in the `imageInterceptor` bean.

```jsp
<%@taglib prefix="c" uri="http://java.sun.com/jsp/jstl/core"%>
<table>
  <c:forEach var="item" items="${imageList}" varStatus="status">
    <c:if test="${(status.index % rowWidth) == 0}">
      <tr>
    </c:if>
    <td>
      <a href="${item.imagePath}">
        <img src="${item.thumbnailPath}"/>
      </a>
    </td>
    <c:if test="${(status.index % 3) == (rowWidth -1)}">
      </tr>
    </c:if>
  </c:forEach>
</table>
```

### 4. Download

If you are using Maven, you can use the Maven dependency below and add a repository definition for the Spring by Example Maven repository. Otherwise you can download the jar directly from the Spring by Example Maven repository (http://www.springbyexample.org/maven/repo/).

```xml
<dependency>
  <groupId>org.springbyexample</groupId>
  <artifactId>sbe-web</artifactId>
  <version>1.1.4</version>
</dependency>
<repositories>
  <repository>
    <id>springbyexample.org</id>
    <name>Spring by Example</name>
    <url>http://www.springbyexample.org/maven/repo</url>
  </repository>
</repositories>
```
5. Reference

Related Links

- Spring by Example Web Module Site [http://springbyexample.org/maven/site/sbe-web/1.1.4/sbe-web/]
- Spring 3.2.x MVC Documentation [http://static.springsource.org/spring/docs/3.2.x/spring-framework-reference/html/mvc.html]
- GWT (Google Web Toolkit) [http://code.google.com/webtoolkit/]
- GWT Widget Library [http://gwt-widget.sourceforge.net/] (see GWTSpringController)
- Jetty Continuations [http://docs.codehaus.org/display/JETTY/Continuations]
- Simple GWT Spring Webapp

Project Setup

Follow the Project Checkout instructions for git, then go to the project (relative path below).

$ cd modules/sbe-web

General Setup Instructions

General instructions for checking out the project with Eclipse and building with Maven.

Example Project Setup

Project Information

- Spring Framework 3.2.x
The Spring Modules [http://www.springsource.org/spring-modules] project has a number of subprojects, including validation. This module is based on Spring Modules [http://www.springsource.org/spring-modules] Validation Version 0.9 and has a number of enhancements to the Valang part of the project.

Thanks to everyone that has worked on this project previously and currently.

1. Valang

Valang is short for Validation Language. It provides a very readable language for expressing validation rules, as well as providing the ability to add custom functions to the language. Once the ValangValidator is configured, using it isn't different than any other Spring Validator since it implements org.springframework.validation.Validator.

Below is a list of current enhancements.

Version 0.91

- Bytecode generation added to DefaultVisitor as a replacement for reflection accessing simple properties (BeanPropertyFunction) for a significant performance improvement.

- Basic enum comparison support. In the expression below the personType is an enum and the value STUDENT will be converted to an enum for comparison. The value must match an enum value on the type being compared or an exception will be thrown.

  personType EQUALS ['STUDENT']

  For better performance the full class name can be specified so the enum can be retrieved during parsing. The first example is for standard enum and the second one is for an inner enum class.

  personType ['org.springmodules.validation.example.PersonType.STUDENT']

  personType ['org.springmodules.validation.example.Person$PersonType.STUDENT']

- Where clause support. In the expression below, the part of the expression price < 100 will only be evaluated if the personType is 'STUDENT'. Otherwise the validation will be skipped.

  price < 100 WHERE personType EQUALS ['STUDENT']

Note
Support for the where clause has not been added to the JavaScript custom tag currently.

- Improved performance of 'IN'/NOT IN' if comparing a value to a java.util.Set it will use Set.contains(value). Static lists of Strings (ex: 'A', 'B', 'C') are now stored in a Set instead of an ArrayList.

- Functions can be configured in Spring, but need to have their scope set as prototype and use a FunctionWrapper that is also a prototype bean with <aop:scoped-proxy> set on it.

- Removed servlet dependency from Valang project except for the custom JSP tag ValangValidateTag needing it, but running Valang no longer requires it. This involved removing ServletContextAware from it's custom dependency injection. If someone was using this in a custom function, the function can now be configured directly in Spring and Spring can inject any "aware" values.

- Changed logging to use SLF4J api.

Version 0.92

- Removed custom dependency injection since functions can be configured in Spring.

- Added auto-discovery of FunctionWrapper beans from the Spring context to go with existing auto-discovery of FunctionDefinition beans.

Version 0.93

- Made specific comparison classes for each operator for a performance improvement.

- Changed IS WORD and IS BLANK to use Commons Lang StringUtils, which will change the behavior slightly but should be more accurate to the description of the validation.

- Change Operator from interfaces to an enum and removed OperatorConstants.

- Fixed bytecode generation to handle a Map, a List, and an Array.

Version 0.94

- Upgraded to Spring 3.0 and changed group & artifact IDs to match standard Spring naming conventions.

Version 0.95

- Upgraded to Spring 3.1 and minor improvements to bytecode generation.

**Rule Syntax**

The basic construction of a Valang rule is to have it begin and end with a brace. Within the braces, the default property name for the rule is specified first. Then the Valang expression, followed by the default error message. These are all the required values for a Valang rule. The other optional values for a rule are the error message key and arguments for it. Each of the values of the rule are delimited by a colon.

```
{ <property-name> : <expression> : <default-error-message> : <error-message-key> : <error-message-args> }
```
### Table 1. Rule Syntax

<table>
<thead>
<tr>
<th>Rule Value</th>
<th>Description</th>
<th>Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>property-name</td>
<td>This is the default property of the bean being targeted for validation, and can be referred to with the shortcut ? in an expression.</td>
<td>true</td>
</tr>
<tr>
<td>expression</td>
<td>The Valang expression.</td>
<td>true</td>
</tr>
<tr>
<td>default-error-message</td>
<td>The default error message. If this isn't needed, it can be left blank even though it's required.</td>
<td>true</td>
</tr>
<tr>
<td>error-message-key</td>
<td>The message resource key for the i18n error message.</td>
<td>false</td>
</tr>
<tr>
<td>error-message-arg</td>
<td>If the error-message-key is specified, arguments for the error message can also be set as the final value of the rule. This accepts a comma delimited list of values.</td>
<td>false</td>
</tr>
</tbody>
</table>

### Expression Syntax

The expression language provides an English like syntax for expressing validation rules. There are a number of operators for comparing a value to another. Logical expressions, resulting in true or false, can be grouped together with parentheses to form more complex expressions.

Just to give some context to the explanation of all the rules, below is a simple example. The bean being validated has the properties getFirstName(), getLastName(), and getAge(). The first two return a String and the last returns an int. The default property is 'firstName', which is referred to by the question mark. The first part of the rule enclosed in parentheses checks if the first name is either 'Joe' or it's length is greater than 5. The next part checks if the last name is one of the values in the list, and the final part checks if the age is over 18.

```
(? EQUALS 'Joe' OR length(?) > 5) AND lastName IN 'Johnson', 'Jones', 'Smith' AND age > 18
```

### Operator Syntax

The parser is not case sensitive when processing the operators.

<table>
<thead>
<tr>
<th>Comparison Operator</th>
<th>Description</th>
<th>Supports</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>=</td>
<td>==</td>
<td>IS</td>
<td>EQUALS</td>
</tr>
<tr>
<td>Comparison Operator</td>
<td>Description</td>
<td>Supports</td>
<td>Example</td>
</tr>
<tr>
<td>---------------------</td>
<td>-------------</td>
<td>----------</td>
<td>---------</td>
</tr>
<tr>
<td><code>!=</code></td>
<td><code>&lt;&gt;</code></td>
<td><code>&lt;&gt;</code></td>
<td><code>&lt;&gt;</code></td>
</tr>
<tr>
<td><code>&gt;</code></td>
<td>GREATER THAN</td>
<td>IS GREATER THAN</td>
<td>Checks if a value is greater than another.</td>
</tr>
<tr>
<td><code>&lt;</code></td>
<td>LESS THAN</td>
<td>IS LESS THAN</td>
<td>Checks if a value is less than another.</td>
</tr>
<tr>
<td><code>&gt;=</code></td>
<td><code>=&gt;</code></td>
<td>GREATER THAN OR EQUALS</td>
<td>IS GREATER THAN OR EQUALS</td>
</tr>
<tr>
<td><code>&lt;=</code></td>
<td><code>=&lt;</code></td>
<td>LESS THAN OR EQUALS</td>
<td>IS LESS THAN OR EQUALS</td>
</tr>
<tr>
<td><code>IS NULL</code></td>
<td>Checks if a value is null.</td>
<td>Objects.</td>
<td><code>firstName IS NULL</code></td>
</tr>
<tr>
<td><code>IS NOT NULL</code></td>
<td>Checks if a value is not null.</td>
<td>Objects.</td>
<td><code>firstName IS NOT NULL</code></td>
</tr>
<tr>
<td><code>HAS TEXT</code></td>
<td>Checks if the value has at least one non-whitespace character.</td>
<td>Strings.</td>
<td><code>firstName HAS TEXT</code></td>
</tr>
<tr>
<td><code>HAS NO TEXT</code></td>
<td>Checks if the value doesn't have a non-whitespace character.</td>
<td>Strings.</td>
<td><code>firstName HAS NO TEXT</code></td>
</tr>
<tr>
<td><code>HAS LENGTH</code></td>
<td>Checks if the value's length is greater than zero.</td>
<td>Strings.</td>
<td><code>firstName HAS LENGTH</code></td>
</tr>
<tr>
<td><code>HAS NO LENGTH</code></td>
<td>Checks if the value's length is zero.</td>
<td>Strings.</td>
<td><code>firstName HAS NO LENGTH</code></td>
</tr>
<tr>
<td><code>IS BLANK</code></td>
<td>Checks if the value is blank (null or zero length).</td>
<td>Strings.</td>
<td><code>firstName IS BLANK</code></td>
</tr>
<tr>
<td><code>IS NOT BLANK</code></td>
<td>Checks if the value isn't blank (not null, length greater than zero).</td>
<td>Strings.</td>
<td><code>firstName IS NOT BLANK</code></td>
</tr>
<tr>
<td><code>IS UPPERCASE</code></td>
<td>IS UPPER CASE</td>
<td>IS UPPER</td>
<td>Checks if the value is uppercase.</td>
</tr>
<tr>
<td><code>IS NOT UPPERCASE</code></td>
<td>IS NOT UPPER CASE</td>
<td>IS NOT UPPER</td>
<td>Checks if the value isn't uppercase.</td>
</tr>
<tr>
<td><code>IS LOWERCASE</code></td>
<td>IS LOWER CASE</td>
<td>IS LOWER</td>
<td>Checks if the value is lowercase.</td>
</tr>
<tr>
<td>Comparison Operator</td>
<td>Description</td>
<td>Supports</td>
<td>Example</td>
</tr>
<tr>
<td>---------------------</td>
<td>-------------</td>
<td>----------</td>
<td>---------</td>
</tr>
<tr>
<td>LOWER CASE</td>
<td>IS LOWER</td>
<td>lowercase.</td>
<td>LOWERCASE</td>
</tr>
<tr>
<td>IS NOT LOWERCASE</td>
<td>IS NOT LOWER CASE</td>
<td>Checks if the value isn't lowercase.</td>
<td>Strings.</td>
</tr>
<tr>
<td>IS WORD</td>
<td>Checks if the value has one or more letters or numbers (no spaces or special characters).</td>
<td>Strings.</td>
<td>firstName IS WORD</td>
</tr>
<tr>
<td>IS NOT WORD</td>
<td>Checks if the value doesn't have one or more letters or numbers (no spaces or special characters).</td>
<td>Strings.</td>
<td>firstName IS NOT WORD</td>
</tr>
<tr>
<td>BETWEEN</td>
<td>Checks if a value is between two other values.</td>
<td>Numbers and dates.</td>
<td>age BETWEEN 18 AND 65</td>
</tr>
<tr>
<td>NOT BETWEEN</td>
<td>Checks if a value isn't between two other values.</td>
<td>Numbers and dates.</td>
<td>age NOT BETWEEN 18 AND 65</td>
</tr>
<tr>
<td>IN</td>
<td>Checks if a value is in a list.</td>
<td>Strings, booleans, numbers, dates, and enums.</td>
<td>firstName IN 'Joe', 'Jack', 'Jane', 'Jill'</td>
</tr>
<tr>
<td>NOT IN</td>
<td>Checks if a value isn't in a list.</td>
<td>Strings, booleans, numbers, dates, and enums.</td>
<td>firstName NOT IN 'Joe', 'Jack', 'Jane', 'Jill'</td>
</tr>
<tr>
<td>NOT</td>
<td>Checks for the opposite of the following expression.</td>
<td>Any expression.</td>
<td>NOT firstName EQUALS 'Joe'</td>
</tr>
<tr>
<td>!</td>
<td>Changes a boolean expression to it's opposite.</td>
<td>Booleans</td>
<td>matches('\s+', firstName) IS !(TRUE)</td>
</tr>
<tr>
<td>AND</td>
<td>Used to join together the logical comparisons on either side of the operator. Both must evaluate to true.</td>
<td>Any expression.</td>
<td>firstName EQUALS 'Joe' AND age &gt; 21</td>
</tr>
<tr>
<td>OR</td>
<td>Used to join together the logical comparisons on either side of the operator. Only one must evaluate to true.</td>
<td>Any expression.</td>
<td>firstName EQUALS 'Joe' OR age &gt; 21</td>
</tr>
<tr>
<td>WHERE</td>
<td>If the where expression is true, then the main</td>
<td>Any expression.</td>
<td>firstName EQUALS 'Joe' WHERE age &gt;</td>
</tr>
</tbody>
</table>
Comparison Operator | Description | Supports | Example
--- | --- | --- | ---
expression for validation is performed. Otherwise it isn't evaluated and no errors are generated. | | | 21
this | A reference to the bean passed in for validation, which could be passed into a custom function for example. | Any expression. | isValid(this) IS TRUE

### Literal Syntax

**Table 3. Literals**

<table>
<thead>
<tr>
<th>Literal Type</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>String</td>
<td>String literals are surrounded by single quotes.</td>
<td>'Joe'</td>
</tr>
<tr>
<td>Numbers</td>
<td>Numbers can be expressed without any special syntax. Numbers are all parsed using BigDecimal.</td>
<td>1, 100, 0.73, -2.48</td>
</tr>
<tr>
<td>Dates</td>
<td>Date literals are surrounded by brackets. These are the supported formats supported by the DefaultDateParser. yyyyMMdd, yyyy-MM-dd, yyyy-MM-dd HH:mm:ss, yyyyMMdd HHmmss, yyyyMMdd HH:mm:ss, yyyy-MM-dd HHmmss</td>
<td>[20081230], [2008-12-30], [2008-12-30 12:20:31]</td>
</tr>
<tr>
<td>Booleans</td>
<td>There are four different constants for boolean values. The values 'TRUE' and 'YES' represent true, and the values 'FALSE' and 'NO' represent false</td>
<td>TRUE, YES, FALSE, NO</td>
</tr>
<tr>
<td>Enums</td>
<td>Enums are surrounded by bracket and single quotes. If the full path to the enum isn't specified, it will be resolved when the expression is evaluated by looking up the enum value from enum on the opposite side of the expression.</td>
<td>['FAIL'], ['org.springmodules.validation.valang.CreditStatus.FAIL'], ['org.springmodules.validation.valang.Person$CreditRating.EXCELLENT'], ['org.springmodules.validation.valang.CreditStatus.FAILED'], ['org.springmodules.validation.valang.Person$CreditRating.EXTREMLY BAD']</td>
</tr>
</tbody>
</table>
Mathematical Operator Syntax

Valang supports basic mathematical formulas based on numeric literals and property values.

Table 4. Mathematical Expression Operators

<table>
<thead>
<tr>
<th>Mathematical Operator</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>+</td>
<td>Addition operator.</td>
<td>price + 12</td>
</tr>
<tr>
<td>-</td>
<td>Subtraction operator.</td>
<td>price - 12</td>
</tr>
<tr>
<td>*</td>
<td>Multiplication operator.</td>
<td>price * 1.2</td>
</tr>
<tr>
<td>/</td>
<td>DIV</td>
<td>Division operator.</td>
</tr>
<tr>
<td>%</td>
<td>MOD</td>
<td>Modulo operator.</td>
</tr>
</tbody>
</table>

Property Syntax

Valang supports standard property and nested property access to the bean passed in for validation.

Table 5. Property Syntax

<table>
<thead>
<tr>
<th>Property Type</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>Using standard JavaBean property notation, a value from the bean being validated may be retrieved. The address represents getAddress() on the bean.</td>
<td>address IS NOT NULL</td>
</tr>
<tr>
<td>Nested</td>
<td>Using standard JavaBean property notation, a nested value from the bean being validated may be retrieved. The address.city represents getAddress().getCity() on the bean.</td>
<td>address.city IS NOT BLANK</td>
</tr>
<tr>
<td>List</td>
<td>From an array, List, or Set, a value from it can be returned by specifying its index. Only arrays and lists are supported by bytecode generation.</td>
<td>addresses[1] IS NOT NULL</td>
</tr>
<tr>
<td>Map</td>
<td>From a Map, the value based on the key specified is retrieved.</td>
<td>addresses[home] IS NOT NULL</td>
</tr>
</tbody>
</table>
These are built in functions that come with Valang. The function framework is pluggable, so it's easy to add custom functions. Adding custom functions will be covered in the next section.

Table 6. Functions

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>length</td>
<td>Returns the size of a collection or an array, and otherwise returns the length of string by called toString() on the object.</td>
<td>length(firstName) &lt; 20</td>
</tr>
<tr>
<td>match</td>
<td>Performs a match on a regular expression. The first argument is the regular expression and the second is the value match on.</td>
<td>matches('\w+', firstName) IS TRUE</td>
</tr>
<tr>
<td>email</td>
<td>Checks if the value is a valid e-mail address.</td>
<td>email(email) IS TRUE</td>
</tr>
<tr>
<td>upper</td>
<td>Converts the value to uppercase.</td>
<td>upper(firstName) EQUALS 'JOE'</td>
</tr>
<tr>
<td>lower</td>
<td>Converts the value to lowercase.</td>
<td>lower(firstName) EQUALS 'joe'</td>
</tr>
<tr>
<td>resolve</td>
<td>Wraps a string in DefaultMessageSourceResolvable.</td>
<td>resolve('personForm.firstName') EQUALS 'First Name'</td>
</tr>
<tr>
<td>inRole</td>
<td>Checks if the user authenticated by Spring Security is in a role.</td>
<td>inRole('ADMIN') IS TRUE</td>
</tr>
</tbody>
</table>

Custom Functions

Custom functions can either be explicitly registered or instances of FunctionDefinition and FunctionWrapper are automatically registered with a ValangValidator. If just specifying a class name, it must have a constructor with the signature Function[] arguments, int line, int column. The FunctionWrapper is specifically for Spring configured functions. If the Function in a FunctionWrapper takes any arguments, it must implement ConfigurableFunction which allows the parser to configure the arguments, line number, and column number. Otherwise the line & column number will not be set on a Spring configured function.

Note

It's important for a FunctionWrapper around a custom Function to be of the scope prototype as well as the FunctionWrapper. Also the FunctionWrapper must have <aop:scoped-proxy/> defined so each call to it will get a new instance of the function. This is because as the validation language is parsed a new instance of a function is made each time and has the arguments specific to that function set on it.
Spring Configuration

The example below shows how to explicitly register a custom function directly with a validator. The custom functions 'validLastName' and 'creditApproval' are registered on the customFunctions property as a Map. The key is the name of the function to be used in the validation language and the value if the function being registered, which can either be the fully qualified name of the class or an instance of FunctionWrapper.

ValangValidatorCustomFunctionTest-context.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xmlns:aop="http://www.springframework.org/schema/aop"
  <bean id="creditApprovalFunction" class="org.springmodules.validation.valang.CreditApprovalFunction" scope="prototype">
    <property name="creditRatingList">
      <list>
        <value>GOOD</value>
        <value>EXCELLENT</value>
      </list>
    </property>
  </bean>
  <bean id="personValidator" class="org.springmodules.validation.valang.ValangValidator">
    <property name="className" value="org.springmodules.validation.valang.Person"/>
    <property name="customFunctions">
      <map>
        <entry key="validLastName">
          <value>org.springmodules.validation.valang.ValidLastNameFunction</value>
        </entry>
        <entry key="creditApproval">
          <bean class="org.springmodules.validation.valang.functions.FunctionWrapper" scope="prototype">
            <aop:scoped-proxy/>
            <property name="function" ref="creditApprovalFunction"/>
          </bean>
        </entry>
      </map>
    </property>
    <property name="valang">
      <![CDATA[
          { lastName : validLastName(?) is true : '' }
          { lastName : creditApproval(age, creditRating) is true : '' }
          { lastName : validLastName(?) is true AND creditApproval(age, creditRating) is true : '' }
          { lastName : validLastName(?) is true AND (creditApproval(age, creditRating) is true OR creditApproval(age, ['org.springmodules.validation.valang.Person$CreditRating.FAIR']) is true) : '' }
      ]]]
    </property>
  </bean>
</beans>
```
Instances of `FunctionDefinition` and `FunctionWrapper` are automatically registered with a `ValangValidator`. The custom functions 'validLastName' and 'creditApproval' are registered. If a `FunctionWrapper` doesn't have a function name specified, the name of the bean will be used for the function name.

*ValangValidatorCustomFunctionDiscoveryTest-context.xml*

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xmlns:aop="http://www.springframework.org/schema/aop"
      xmlns:p="http://www.springframework.org/schema/p"
      xsi:schemaLocation="http://www.springframework.org/schema/beans
      http://www.springframework.org/schema/beans/spring-beans.xsd
      http://www.springframework.org/schema/aop
      http://www.springframework.org/schema/aop/spring-aop.xsd">
  <bean class="org.springmodules.validation.valang.functions.FunctionDefinition"
        p:name="validLastName"
        p:className="org.springmodules.validation.valang.ValidLastNameFunction"/>
  <!-- Uses bean name for function name if not explicitly set on the wrapper -->
  <bean id="creditApproval"
        class="org.springmodules.validation.valang.functions.FunctionWrapper"
        scope="prototype">
    <aop:scoped-proxy/>
    <property name="function">
      <bean id="creditApprovalFunction"
            class="org.springmodules.validation.valang.CreditApprovalFunction"
            scope="prototype">
        <property name="creditRatingList">
          <list>
            <value>GOOD</value>
            <value>EXCELLENT</value>
          </list>
        </property>
      </bean>
    </property>
  </bean>
  <bean id="personValidator" class="org.springmodules.validation.valang.ValangValidator">
    <property name="className" value="org.springmodules.validation.valang.Person"/>
    <property name="valang">
      <![CDATA[
        { lastName : validLastName(?) is true : '' }
        { lastName : creditApproval(age, creditRating) is true : '' }
        { lastName : validLastName(?) is true AND creditApproval(age, creditRating) is true :
          '' }
        { lastName : validLastName(?) is true AND creditApproval(age, creditRating) is true OR
          creditApproval(age,
```
### Code Example

Checks if the last name is in a list, and if it isn't **false** is returned.

```java
public class ValidLastNameFunction extends AbstractFunction {

    final Logger logger = LoggerFactory.getLogger(ValidLastNameFunction.class);

    final Set<String> lValidLastNames = new HashSet<String>();

    /**
     * Constructor
     */
    public ValidLastNameFunction(Function[] arguments, int line, int column) {
        super(arguments, line, column);
        definedExactNumberOfArguments(1);

        lValidLastNames.add("Anderson");
        lValidLastNames.add("Jackson");
        lValidLastNames.add("Johnson");
        lValidLastNames.add("Jones");
        lValidLastNames.add("Smith");
    }

    /**
     * Checks if the last name is blocked.
     *
     * @return Object Returns a <code>boolean</code> for whether or not the last name is blocked.
     */
    @Override
    protected Object doGetResult(Object target) {
        boolean result = true;

        String symbol = getArguments()[0].getResult(target).toString();

        if (!lValidLastNames.contains(symbol)) {
            result = false;
        }

        return result;
    }
}
```

**Example 1 ValidLastNameFunction**

The function checks if a person can get credit approval. Their credit rating is checked against a list only if they are over 18 years old.
public class CreditApprovalFunction extends AbstractFunction
    implements ConfigurableFunction {

    final Logger logger = LoggerFactory.getLogger(CreditApprovalFunction.class);

    Set<Person.CreditRating> lCreditRatings = new HashSet<Person.CreditRating>();

    /**
     * Constructor
     */
    public CreditApprovalFunction() {
    }

    /**
     * Constructor
     */
    public CreditApprovalFunction(Function[] arguments, int line, int column) {
        super(arguments, line, column);
        definedExactNumberOfArguments(2);
        lCreditRatings.add(Person.CreditRating.FAIR);
        lCreditRatings.add(Person.CreditRating.GOOD);
        lCreditRatings.add(Person.CreditRating.EXCELLENT);
    }

    /**
     * Gets number of expected arguments.
     * Implementation of <code>ConfigurableFunction</code>.
     */
    public int getExpectedNumberOfArguments() {
        return 2;
    }

    /**
     * Sets arguments, line number, and column number.
     * Implementation of <code>ConfigurableFunction</code>.
     */
    public void setArguments(int expectedNumberOfArguments, Function[] arguments, int line, int column) {
        super.setTemplate(line, column);
        super.setArguments(arguments);
        super.definedExactNumberOfArguments(expectedNumberOfArguments);
    }

    /**
     * Sets valid credit rating approval list.
     */
    public void setCreditRatingList(Set<Person.CreditRating> lCreditRatings) {
        this.lCreditRatings = lCreditRatings;
    }

    /**
     * If age is over 18, check if the person has good credit,
     * and otherwise reject.
     * @return Object Returns a <code>boolean</code> for
     * whether or not the person has good enough
     * credit to get approval.
     */
    @Override
    protected Object doGetResult(Object target) {
        boolean result = true;

        int age = (Integer) getArguments()[0].getResult(target);
        Person.CreditRating creditRating = (Person.CreditRating) getArguments()[1].getResult(target);

        // must be over 18 to get credit approval

    }
if (age > 18) {
    if (!lCreditRatings.contains(creditRating)) {
        result = false;
    }
}
return result;

Example 2 ConfigurableFunction

Bytecode Generation

If the validator will only be used to validate a specific class, the property 'className' can be specified to avoid reflection. If it's set, a custom Function will be generated that directly retrieves a property to avoid reflection. This provides a significant performance improvement if that is a concern, which typically isn't if the validation is being used to validate a web page since the delay is so small either way.

Note

Only a Map, a List, or an Array is supported by bytecode generation, not a Set. Primitive arrays currently aren't supported, but any object one is. Also, nested properties are currently not supported.

This is a small excerpt from the logging of the performance unit test. As you can see from the logging, as the validator is initialized it generates bytecode and shows for which class and method, as well as what the generated class name is. The package and name of the original class is used and then has what property is being retrieved appended along with 'BeanPropertyFunction$$Valang' to make a unique class name to try to avoid any collisions.

Results from ValangValidatorPerformanceTest which was run on a Macbook Pro (2.3GHz Intel Core i7 with 8 GB RAM with OS X 10.6.8) with Java 6. All the expressions are identical, but adjusted to either retrieve the values being compared from a JavaBean, Map, List, or an array.

Table 7. Bytecode Generation Performance Comparison
<table>
<thead>
<tr>
<th>Expression</th>
<th>Reflection</th>
<th>Bycode Generation</th>
</tr>
</thead>
<tbody>
<tr>
<td>{ lastName : validLastName(?) is true AND creditApproval(age, creditRating) is true WHERE firstName IN 'Joe', 'Jack', 'Jill', 'Jane' AND creditStatus IN ['org.springmodules.validation.valang.CreditStatus.PENDING', 'org.springmodules.validation.valang.CreditStatus.FAIL'] AND creditRating EQUALS 'org.springmodules.validation.valang.Person$CreditRating.EXCELLENT' AND age &gt; 18 : '' }</td>
<td>CreditStatus.PENDING, CreditStatus.FAIL</td>
<td>327ns</td>
</tr>
<tr>
<td>{ mapVars[lastName] : validLastName(?) is true AND creditApproval(mapVars[age], mapVars[creditRating]) is true WHERE mapVars[firstName] IN 'Joe', 'Jack', 'Jill', 'Jane' AND mapVars[creditStatus] IN ['org.springmodules.validation.valang.CreditStatus.PENDING', 'org.springmodules.validation.valang.CreditStatus.FAIL'] AND mapVars[creditRating] EQUALS 'org.springmodules.validation.valang.Person$CreditRating.EXCELLENT' AND mapVars[age] &gt; 18 : '' }</td>
<td>CreditStatus.PENDING, CreditStatus.FAIL</td>
<td>48ns</td>
</tr>
</tbody>
</table>
Spring Configuration

By specifying the 'className' property, bytecode will be generated for each method being called to avoid reflection. This gives a significant performance improvement.

Excerpt from ValangValidatorCustomFunctionTest-context.xml

```xml
<!--
Only perform validation if valid first name, credit status is failed or pending,
and the credit rating is excellent where the person's age is over 18.
-->
<bean id="expression" class="java.lang.String">
  <value><![CDATA[
  { lastName : validLastName(?) is true AND creditApproval(age, creditRating) is true
    WHERE firstName IN 'Joe', 'Jack', 'Jill', 'Jane' AND
    creditStatus IN
    ['org.springmodules.validation.valang.CreditStatus.PENDING'],
    ['org.springmodules.validation.valang.CreditStatus.FAIL']
    AND creditRating EQUALS
    ['org.springmodules.validation.valang.Person$CreditRating.EXCELLENT']
    AND age > 18 : '' }
  ]]]></value>
</bean>

<bean id="bytecodePersonValidator" class="org.springmodules.validation.valang.ValangValidator">
  <property name="className" value="org.springmodules.validation.valang.Person"/>
  <property name="valang" ref="expression"/>
</bean>
```

Date Examples

The default date parser provides support for a number of different date literals, and also has support for shifting and manipulating dates. Below are a few examples, but see the DefaultDateParser for more detailed information.

Spring Configuration

ValangValidatorDateTest-context.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:aop="http://www.springframework.org/schema/aop"
    xsi:schemaLocation="http://www.springframework.org/schema/beans
    http://www.springframework.org/schema/beans/spring-beans.xsd
    http://www.springframework.org/schema/aop
    http://www.springframework.org/schema/aop/spring-aop.xsd">
  <bean id="personValidator" class="org.springmodules.validation.valang.ValangValidator">
    <property name="className" value="org.springmodules.validation.valang.Person"/>
    <property name="valang" ref="expression"/>
  </bean>
</beans>
```
2. Download

If you are using Maven, you can use the Maven dependency below and add a repository definition for the Spring by Example Maven repository. Otherwise you can download the jar directly from the Spring by Example Maven repository (http://www.springbyexample.org/maven/repo/).

```xml
<dependency>
  <groupId>org.springbyexample</groupId>
  <artifactId>sbe-validation</artifactId>
  <version>0.96</version>
</dependency>

<repositories>
  <repository>
    <id>springbyexample.org</id>
    <name>Spring by Example</name>
    <url>http://www.springbyexample.org/maven/repo</url>
  </repository>
</repositories>
```

3. Reference

Related Links

- Spring by Example Validation Site [http://springbyexample.org/maven/site/sbe-validation/0.95/sbe-validation/]
Project Setup

Follow the Project Checkout instructions for git, then go to the project (relative path below).

```
cd modules/sbe-validation
```

General Setup Instructions

General instructions for checking out the project with Eclipse and building with Maven.

Example Project Setup

Project Information

- Spring Framework 3.2.x
Appendix A. Setup

A.1. Project Setup

The latest Spring by Example repository is available at https://github.com/spring-by-example/spring-by-example.

Older projects can be checked out directly from the Subversion repository located at http://svn.springbyexample.org/.

The projects were setup to be imported as Maven projects into Eclipse, but because of some issues some Eclipse files are checked for reference. Maven can also be used to generate IntelliJ project files.

```
$ mvn idea:idea
```

Basic Setup

1. Java 7 or higher installed with JAVA_HOME set.

2. Download and install to use Maven from the command line. Maven [http://maven.apache.org/] (version 3.x or higher).

3. Install Git [http://git-scm.com/].

Example Environment Settings

These are the ~/.bash_profile settings for a Mac.

```
JAVA_HOME=/Library/Java/JavaVirtualMachines/jdk1.7.0_10.jdk/Contents/Home
MAVEN_OPTS="-Xms256m -Xmx1024m -XX:MaxPermSize=256M"

PATH=$PATH:JAVA_HOME/bin
export JAVA_HOME MAVEN_OPTS
```

Project Checkout

Checkout the project using Git [http://git-scm.com/] from Spring By Example Repository [https://github.com/spring-by-example/spring-by-example]. The first command will checkout all of the current Spring by Example projects, and the second will checkout the specific tag that corresponds to this document.

```
$ git clone git://github.com/spring-by-example/spring-by-example.git
$ cd spring-by-example
$ git checkout sbe-1.3
```
SpringSource Tool Suite Setup


- SpringSource Tool Suite Download [http://www.springsource.com/products/sts]

General Eclipse IDE Setup

Project Checkout

1. Navigate to the projects trunk using the Subversion repository browser.
2. Right click on 'trunk', select 'Checkout...', click on the 'Finish' button.

Web Setup

2. Show Sever View
   - Window/Show View/Others...
   - Server/Servers
3. Right click in the Server View and select 'New/Server'.
   - Choose the installed server (for example Tomcat [http://tomcat.apache.org/] if that is the server you chose to install).
4. Right click on project and select 'Run As'/Run on Server'.
   - Choose the server to run the project on.
   - Click on Next.
   - Click on Finish.
   - This should launch the application and also open up a browser window in Eclipse pointing to the webapps home page.
Appendix B. Author Bios

B.1. David Winterfeldt

Introduction

David has been doing software development for over 20 years. He's been using Java since 1998 and involved in using Open Source almost as long. David has focused on Web and Enterprise development for most of his career, and started working with the Spring Framework in 2006. He started working with Spring 2.0 towards the end of 2006 and really enjoy working with the Spring Framework. He really enjoys it because it not only saves time, but encourages better design and code reuse through loosely coupled components.

David started Spring by Example [http://www.springbyexample.org/] to post different examples he had been doing, and also to become involved again with Open Source projects. Spring by Example [http://www.springbyexample.org/] is a general resource for Spring and should ultimately save developers time.

Currently David works at VMware on the VMware vFabric Application Director [http://www.vmware.com/products/application-platform/vfabric-application-director/overview.html] project. It enables developers and organizations to deploy applications to the cloud by having a logical abstraction for software services and application topologies. This allows an application to be easily deployed multiple times to different environments.

David is also a committer on Struts [http://struts.apache.org/] and Commons Validator [http://commons.apache.org/validator/], but is no longer active on either. He was also the creator of Commons Validator [http://commons.apache.org/validator/].
Technical Expertise

• Publications

• Co-author of Spring In-depth, In Context [http://www.springindepth.com/], which is a free, but incomplete (stopped due to time constraints), online book for the Spring Framework.

• Co-author of the validation chapter in Struts in Action: Building Web Applications with the Leading Java Framework, Manning Publications (November 2002) [http://www.manning.com/husted/].

• Conference Speaker


• Speaker at NY Java SIG [http://www.javasig.com/] in January 2013 presenting Deploying Spring Apps to Amazon EC2 and VMware vCloud [http://javasig-spring.eventbrite.com/].


• Speaker at SpringOne Americas 2008 [http://www.springone2gx.com/] presenting Case Study: GWT & Comet Integration with the Spring Framework at NYSE [http://www.springone2gx.com/m/mobile/presentation.jsp?showId=172&presentationId=12842].

• Open Source Contributions

• Original developer of Commons Validator and its integration into Struts.

• Committer on Struts (http://struts.apache.org) and the Commons Validator (http://jakarta.apache.org/commons).

• Webmaster of Spring by Example (http://www.springbyexample.org [http://jakarta.apache.org/commons]).

• Architecture & Design

• Struts Validator & Commons Validator with matching client side JavaScript validation

• Scalable E-mail Framework with scheduling, retry process, template processing, and dynamic population processing

• Keyword based E-mail Alert System for online articles
• Scalable Publishing System with configurable publishing processes

• Multi-threaded, multi-tier servers with custom thread pools and tcp/ip socket connections for a client entry prototype system.

• Programming Languages

• Java 1.0/1.1.x/1.2.x/1.3.x/1.4.x/1.5/1.6, Perl, JavaScript, SQL, PL/SQL

• Java EE

• JDBC, RMI, JavaMail, JMS, EJBs (Stateless, Session, Message Driven, Entity), RMI, JSPs, Servlets, Web Services, XML, JTA

• Application Servers

• Jetty 6.x, Tomcat 3.x/4.x/5.0/5.5/6.0, Spring dm Server, JBoss, BEA Weblogic Application Server 4.0/4.5/5.1/7.0

• Databases

• Oracle 8i/9i, DB2, MS SQL*Server 6.0/6.5/7.0, MySQL, PostgreSQL, MS Access, FoxPro

• Open Source Frameworks

• Spring Framework, Spring Security, Spring Web Flow, Spring Web Services, Struts, GWT, Hibernate, Velocity Template Engine, Axis, OSGi

• Open Source Projects

• Ant, Maven, AspectJ, Jakarta Commons BeanUtils, Jakarta Commons Betwixt, Jakarta Commons Collections, Jakarta Commons Digester, Jakarta Commons IO, Jakarta Commons Lang, Jakarta Commons Validator, Jakarta ORO, Jakarta POI, Jakarta Regexp, Tiles, Log4J, LOGBack, Xalan, Xerces, JUnit, HttpUnit, Cactus, XDoclet

• Miscellaneous

• Windows 2000 Server, Windows XP, Mac OS X, Solaris, Linux, Eclipse IDE

**Experience**

• Lead Architect: Designing systems/frameworks, preparing projects and frameworks for developers on new projects, providing instruction and assistance to developers.

• Ability to interact with Business Analysts, and Clients to gather requirements and implement.

• Performance Enhancements: database performance, adding multi-threading, optimizing code.

• Interaction with clients to define specifications, gather requirements, and communicate & resolve issues.

• Documentation: Javadocs, Wiki based documentation for developers, technical specifications.
• Interpreting specifications and requirement documents into working systems.

• Ability to learn new technologies, investigate issues, resolve development issues.

• Working with distributed team environments.

Sites & Blogs

• Spring by Example - http://www.springbyexample.org/

• Blog - http://davidwinterfeldt.blogspot.com/

• Spring by Example Blog - http://springbyexample.blogspot.com/

• Twitter - http://twitter.com/dwinterfeldt

Contact Info

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