Managed Beans I – Classes to Represent Form Info

JSF 2.2 Version

Originals of slides and source code for examples: http://www.coreservlets.com/JSF-Tutorial/jsf2/
Also see the PrimeFaces tutorial – http://www.coreservlets.com/JSF-Tutorial/primefaces/
and customized JSF2 and PrimeFaces training courses – http://courses.coreservlets.com/jsf-training.html

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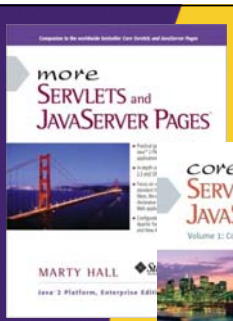
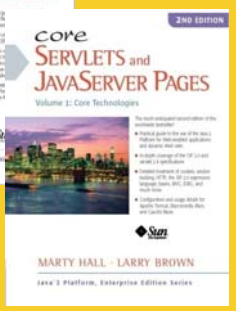
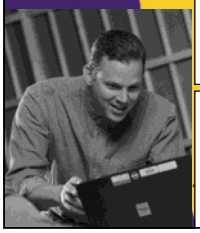






Topics in This Section

- **Basic beans and "managed" beans**
- **Three parts of beans in JSF**
  - Getter/setter methods to represent input elements
  - Action controller method
  - Placeholder for results (properties derived from input)
- **Business logic**
  - How to prevent changes in the way that the data is found from rippling through the rest of the code
    - Making separate method
    - Passing and returning simple types
    - Coding to interfaces
    - Using dependency injection

Basic Beans and "Managed" Beans

Background: Basic JavaBeans

- **Java classes that follow certain conventions**
  - Must have a zero-argument (empty) constructor
    - You can satisfy this requirement either by explicitly defining such a constructor or by omitting all constructors
  - Should have no public instance variables (fields)
    - You should already follow this practice and use accessor methods instead of allowing direct access to fields
  - Persistent values should be accessed through methods called get*Blah* and set*Blah*
    - If class has method getTitle that returns a String, class is said to have a String *property* named title
      - JSF uses #{book.title} to mean "call getTitle on 'book' ".
    - Boolean properties may use is*Blah* instead of get*Blah*
    - What matters is method name, not instance variable name

More on Bean Properties

- **Usual rule to turn method into property**
  - Drop the word "get" or "set" and change the next letter to lowercase. Instance variable name is irrelevant.
    - Method name: getFirstName
    - Property name: firstName
    - Example: #{customer.firstName}
- **Exception 1: boolean properties**
  - If getter returns boolean or Boolean
    - Method name: getPrime or isPrime (isPrime is preferred)
    - Property name: prime
    - Example: #{myNumber.prime}
- **Exception 2: consecutive uppercase letters**
  - If two uppercase letters in a row after "get" or "set"
    - Method name: getURL
    - Property name: URL (not uRL)
    - Example: #{webSite.URL}

If you write the methods, it is considered better practice to avoid the consecutive uppercase letters, and to call the method getUrl, not getURL.

Bean Properties: Examples

Method Names	Property Name	Example JSF Usage
getFirstName setFirstName	firstName	#{customer.firstName} <h:inputText value="#{customer.firstName}"/>
isExecutive setExecutive (boolean property)	executive	#{customer.executive} <h:selectBooleanCheckbox value="#{customer.executive}"/>
getExecutive setExecutive (boolean property)	executive	#{customer.executive} <h:selectBooleanCheckbox value="#{customer.executive}"/>
getZIP setZIP	ZIP	#{address.ZIP} <h:inputText value="#{address.ZIP}"/>

Note 1: property name does not exist anywhere in your code. It is just a shortcut for the method names. Instance variable name is irrelevant.
Note 2: if you can choose the method names, it is better to avoid consecutive uppercase letters.
E.g., use getZip and getUrl, not getZIP and getURL.

Why You Should Use Accessors, Not Public Fields

- **Bean rules**
  - To be a bean, you should use accessors, not public fields
    - Wrong

```
public double speed;
```

    - Right

```
private double speed;  // Var name need not match method name

public double getSpeed() {
    return(speed);
}

public void setSpeed(double speed) {
    this.speed = speed;
}
```

Note: in Eclipse, after you create instance variable, if you R-click and choose "Source", it gives you option to generate getters and setters for you.

- **OOP design**
  - You should do this in *all* your Java code anyhow. Why?

Why You Should Use Accessors, Not Public Fields

- **1) You can put constraints on values**

```
public void setSpeed(double newSpeed) {
  if (newSpeed < 0) {
     sendErrorMessage(...);
     newSpeed = Math.abs(newSpeed);
  }
  speed = newSpeed;
}
```

  - If users of your class accessed the fields directly, then they would each be responsible for checking constraints.

Why You Should Use Accessors, Not Public Fields

- **2) You can change your internal representation without changing interface**

```
// Instance var changed to store
// metric units (kph, not mph)

public void setSpeed(double newSpeed) {  // MPH
  speedInKph = convertMphToKph(newSpeed);
}

public void setSpeedInKph(double newSpeed) {
  speedInKph = newSpeed;
}
```

Why You Should Use Accessors, Not Public Fields

- **3) You can perform arbitrary side effects**

```
public double setSpeed(double newSpeed) {
  speed = newSpeed;
  updateSpeedometerDisplay();
}
```

  - If users of your class accessed the fields directly, then they would each be responsible for executing side effects. Too much work and runs huge risk of having display inconsistent from actual values.

Basic Beans: Bottom Line

- **It is no onerous requirement to be a "bean"**
  - You are probably following most of the conventions already anyhow
    - Zero arg constructor
    - No public instance variables
    - Use getBlah/setBlah or isBlah/setBlah naming conventions
- **JSF often refers to "bean properties"**
  - Which are shortcuts for getter/setter methods
    - getFirstName method: refer to "firstName"
      - #{customer.firstName}
    - isVeryCool method (boolean): refer to "veryCool"
      - #{invention.veryCool}
    - getHTML method: refer to "HTML" (not "hTML")
      - #{message.HTML}

Managed Beans

- **JSF automatically "manages" certain beans**
  - Instantiates it
    - Thus the need for a zero-arg constructor
  - Controls its lifecycle
    - Scope (request, session, application, etc.) determines lifetime
  - Calls setter methods
    - I.e., for <h:inputText value="#{customer.firstName"/>, when form submitted, the value is passed to setFirstName
  - Calls getter methods
    - #{customer.firstName} results in calling getFirstName
- **Declaring managed beans**
  - Simplest: @ManagedBean before class
    - Results in request scope. See next lecture for other scopes.
  - More powerful: <managed-bean> in faces-config.xml
    - See separate section on navigation and faces-config.xml

Performance Principle: Make Getter Methods Fast

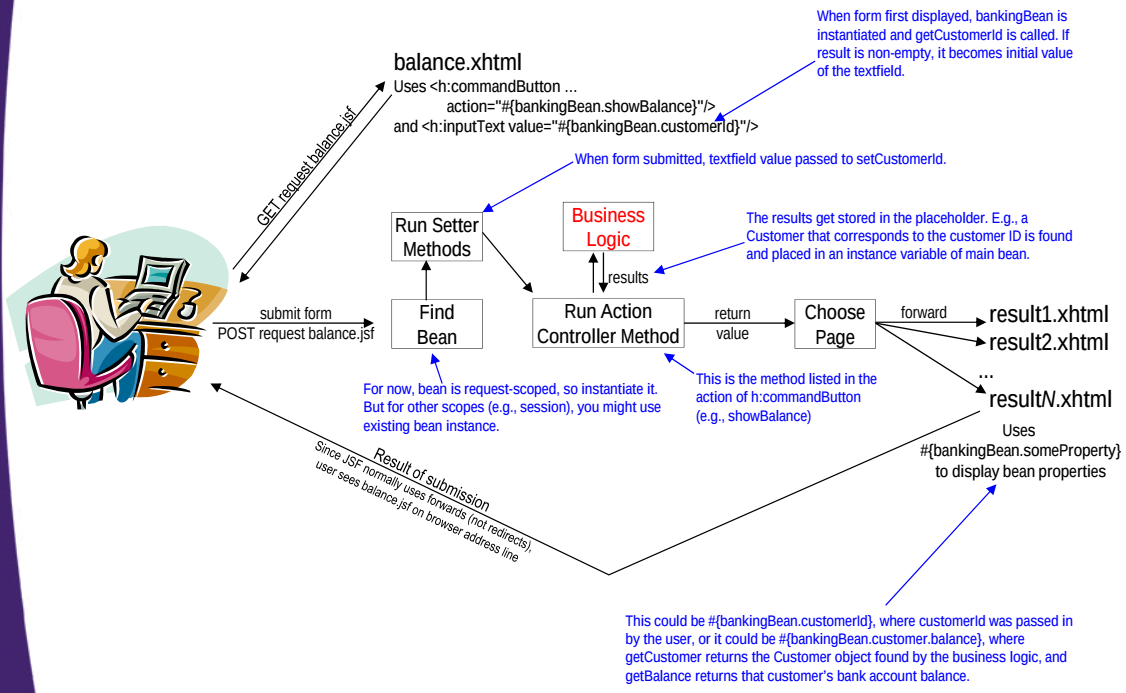
- **Problem**
  - Getter methods of managed beans called several times.
    - E.g., at a minimum, once when form is displayed (<h:inputText value="#{user.customerId}"/>) and again when result is shown (#{user.customerId}).
      - But often extra times, depending on JSF version. Details:
        - » http://stackoverflow.com/questions/4669651/jsf-2-0-primefaces-2-2rc2-performance-issues
        - » http://www.java.net/node/706733
        - » http://stackoverflow.com/questions/2090033/why-jsf-calls-getters-multiple-times
  - If getter method talks to database or does other expensive operation, performance can be unexpectedly bad.
- **Solution**
  - Have action controller store data in instance variables, have getter methods merely return the existing values.
    - Applies to managed beans only, not to "regular" beans.

Business Logic and the Three Parts of Managed Beans

Overview

- **Managed beans typically have three parts**
  - Bean properties (i.e., pairs of getter and setter methods)
    - One pair for each input element
    - Setter methods called automatically by JSF when form submitted. Called *before* action controller method.
  - Action controller methods
    - Often only one, but could be several if the same form has multiple buttons
    - Action controller method (corresponding to the button that was pressed) called automatically by JSF
  - Placeholders for results data
    - Not automatically called by JSF: to be filled in by action controller method based on results of business logic.
    - Needs a getter method so value can be output in results page, but no requirement to have a setter method.

JSF Flow of Control (Updated but Still Simplified)



Business Logic: Overview

- **Big idea**
  - The results page usually shows more than just the data the user entered: it normally also shows data *derived* from the user data (e.g., the user enters a bank account number and you display the account balance).
- **Goal**
  - Isolate the code that looks up the derived data, so that changes to the way the data is calculated do not require changes in the rest of the code. See next slide for four approaches. The first two (separate methods and simple types) should *always* be done and the other two (coding to interfaces and using dependency injection) should be considered for complex applications.

Approaches to Business Logic: Summary

- **Use a separate method** (do always)
  - Do not compute the derived data directly in the action controller method, but use a separate method.
- **Simple types in, simple types out** (do always)
  - Never return a ResultSet or anything specific to *how* you found the data. Return an object representing the result itself.
- **Code to interfaces** (do usually)
  - Make an interface such as CustomerLookupService and use that type. Prevents accidental dependence on concrete type.
- **Use dependency injection** (do sometimes)
  - Inject the concrete type so nothing in main class changes when you swap out concrete implementations of the interface.

Interfaces and Dependency Injection: Analogous Example

- **List<String> names = new ArrayList<>();**

- **Questions**
  - What is benefit of using List instead of ArrayList above?
  - What if you want to switch from ArrayList to LinkedList without changing *any* code in the main class?

Approaches to Business Logic: Details

- **Use a separate method**
  - Do not compute the derived data directly in the action controller method, but use a separate method. E.g.:

```
private static CustomerLookupService lookupService = …;
…
Customer cust = lookupService.findCustomer(idFromUser);
```

- **Simple types in, simple types out**
  - Never return a ResultSet, a Spring object, a Hibernate object, a Web Services object, or anything specific to *how* you found the data. Return a Java object representing the results data itself.
    - E.g., Customer above is a POJO that represents the final answer; it has no ties to the specific manner in which the customer was found from the ID.

Approaches to Business Logic: Details (Continued)

- **Code to interfaces**
  - Make an interface such as CustomerLookupService and use that type so you cannot accidentally do something specific to the concrete implementation.

```
private static CustomerLookupService lookupService =
  new SomeConcreteVersion();
```

- **Use dependency injection**
  - In the above example, there is still *one* line of code that has to change when you switch implementations. Inject the concrete type so *nothing* in main class changes when you switch concrete implementations of the interface. Change separate class (the bean named currentLookupService) instead.

```
@ManagedProperty(value="#{currentLookupService}")
private CustomerLookupService lookupService;
```

    - Details on this syntax covered in next section (Managed Beans 2)

Example

- **Idea**
  - Enter a bank customer id and a password
  - Get either
    - Page showing first name, last name, and balance
      - Three versions depending on balance
    - Error message about missing or invalid data
- **What managed bean needs**
  - Bean properties corresponding to input elements
    - I.e., getCustomerId/setCustomerId, getPassword/setPassword
  - Action controller method
    - Maps a customer ID to a Customer and stores the Customer in an instance variable
  - Placeholder for results data
    - An initially empty instance variable (for storing the Customer) and associated getter method.

Input Form (bank-lookup.xhtml)

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
  "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml"
      xmlns:h="http://xmlns.jcp.org/jsf/html">
…
<h:body>
…
<fieldset>
<legend>Bank Customer Lookup (Request Scope)</legend>
<h:form>
  Customer ID:
  <h:inputText value="#{bankingBean.customerId}"/><br/>
  Password:
  <h:inputSecret value="#{bankingBean.password}"/><br/>
  <h:commandButton value="Show Current Balance"
                   action="#{bankingBean.showBalance}"/>
</h:form>
</fieldset>
…
</h:body></html>
```

This value plays a dual role. When form is first displayed, bankingBean is instantiated and getCustomerId is called. If the value is non-empty, that result is the initial value of the textfield. Otherwise, the textfield is initially empty. When the form is submitted, bankingBean is reinstantiated (since it is request scoped, not session scoped) and the value in the textfield is passed to setCustomerId.

BankingBean.java: Part 1 (Bean Properties for Input Elements)

```
@ManagedBean
public class BankingBean  {
  private String customerId, password;

  public String getCustomerId() {
    return(customerId);
  }
  public void setCustomerId(String customerId) {
    this.customerId = customerId.trim();
    if (this.customerId.isEmpty()) {
      this.customerId = "(none entered)";
    }
  }
  public String getPassword() {
    return(password);
  }
  public void setPassword(String password) {
    this.password = password;    }
```

Called by JSF when form first displayed. Since it returns null in that case, the textfield is left blank initially.

When form submitted, the bean is instantiated again (since it is request-scoped, not session-scoped) and the value in the textfield is passed to this method.

getPassword and setPassword mostly have the same behavior as getCustomerId and setCustomerId above, but with the exception that the return value of getPassword does not affect the initial value of the password field, since browsers do not let you prefill values in password fields.

BankingBean.java: Part 2 (Action Controller Method)

```
  private static CustomerLookupService lookupService =
    new CustomerSimpleMap();

  public String showBalance() {
    if (!password.equals("secret")) {
      return("wrong-password");
    }
    customer = lookupService.findCustomer(customerId);
    if (customer == null) {
      return("unknown-customer");
    } else if (customer.getBalance() < 0) {
      return("negative-balance");
    } else if (customer.getBalance() < 10000) {
      return("normal-balance");
    } else {
      return("high-balance");
    }
  }
```

Filled in by JSF before this action controller method is called.

The customer is not filled in automatically by JSF, since it is not directly part of the submitted data, but rather indirectly derived (by the business logic) from the submitted data. So, it is filled in by this action controller method.

There are five possible results pages: wrong-password.xhtml, unknown-customer.xhtml, negative-balance.xhtml, normal-balance.xhtml, and high-balance.xhtml. We are using the default mapping of return values to file names in all cases (rather than explicit navigation rules in faces-config.xml).

BankingBean.java: Part 3 (Placeholder for Results)

```
private Customer customer;

public Customer getCustomer() {
  return(customer);
}
```

Filled in by the action controller method based on the value returned by the business logic.

The getCustomer method is needed because the results page does #{bankingBean.customer.firstName} and #{bankingBean.customer.otherProperties}. But no setter method is needed since this property does not correspond directly to input data, and this property is not automatically filled in by JSF.

Business Logic (Interface)

```
public interface CustomerLookupService {
  public Customer findCustomer(String id);
}
```

Business Logic (Implementation)

```
public class CustomerSimpleMap
       implements CustomerLookupService {
  private Map<String,Customer> customers;

  public CustomerSimpleMap() {
    customers = new HashMap<>();
    addCustomer(new Customer("id001", "Harry",
                             "Hacker", -3456.78));
    addCustomer(new Customer("id002", "Codie",
                             "Coder", 1234.56));
    addCustomer(new Customer("id003", "Polly",
                             "Programmer", 987654.32));
  }
```

Provides some simple hardcoded test cases.

Business Logic (Implementation, Continued)

```
  @Override
  public Customer findCustomer(String id) {
    if (id != null) {
      return(customers.get(id.toLowerCase()));
    } else {
      return(null);
    }
  }

  private void addCustomer(Customer customer) {
    customers.put(customer.getId(), customer);
  }
}
```

Results Pages: Good Input (normal-balance.xhtml)

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
  "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml"
      xmlns:h="http://xmlns.jcp.org/jsf/html">
<h:head>
…
</h:head>
<h:body>
…
<ul>
  <li>First name: #{bankingBean.customer.firstName}</li>
  <li>Last name: #{bankingBean.customer.lastName}</li>
  <li>ID: #{bankingBean.customer.id}</li>
  <li>Balance: $#{bankingBean.customer.balanceNoSign}</li>
</ul>
…
</h:body></html>
```

negative-balance.xhtml and high-balance.xhtml are similar.

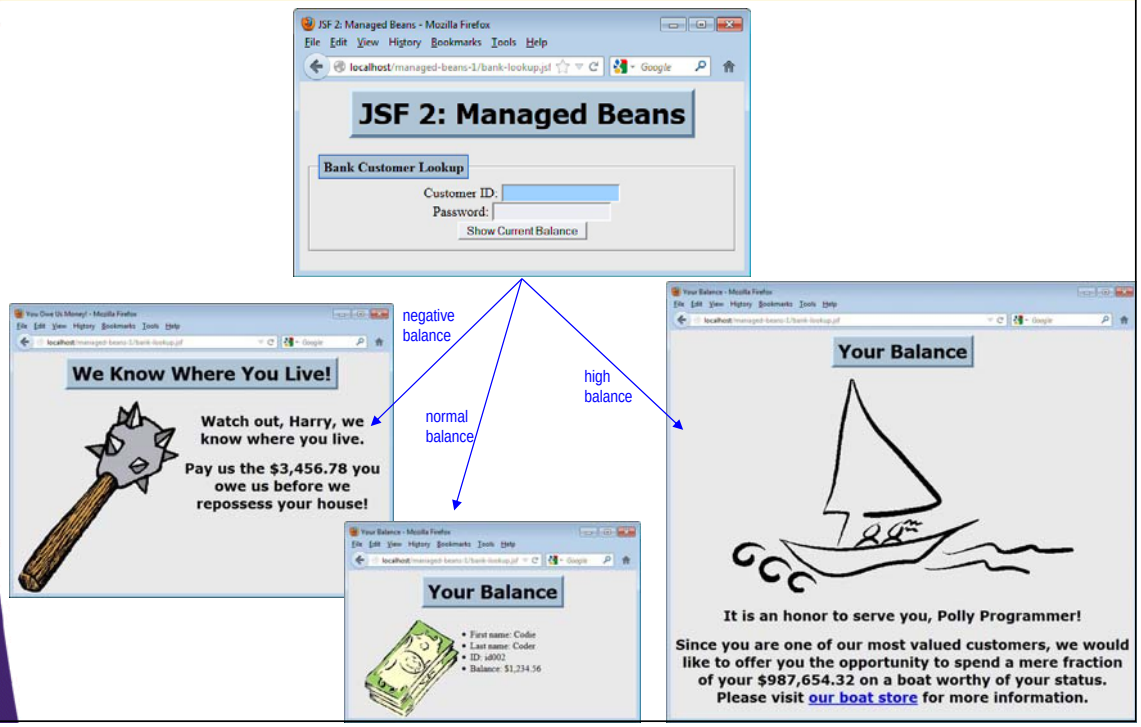
Results Pages: Bad Input (unknown-customer.xhtml)

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
  "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml"
      xmlns:h="http://xmlns.jcp.org/jsf/html">
<h:head>
…
</h:head>
<h:body>
…
<h2>No customer found with id "#{bankingBean.customerId}"</h2>
<p>Please <a href="bank-lookup.jsf">try again</a>.</p>
…
</h:body></html>
```

Even though customerId came from the user and could contain HTML tags, it is safe to use #{bankingBean.customerId} instead of <h:outputText value="#{bankingBean.customerId}"/>. The same HTML escaping is done for #{result} as for <h:outputText value="#{result}"/>

unknown-password.xhtml is similar.

Results (Legal ID and Password)



Results (Bad Inputs)

Wrap-Up

Summary

- **Managed beans generally have three sections**
  - Bean properties to represent input elements
  - Action controller method
  - Placeholder for results (properties *derived* from input)
- **Business logic**
  - Apply strategies to limit ripple effect when data-lookup methods change. Most importantly, never return something like ResultSet or Hibernate object specific to the way in which you found the answer. Instead, return simple Java object representing the answer itself.

Questions?

More info:
http://www.coreservlets.com/JSF-Tutorial/jsf2/ – JSF 2.2 tutorial
http://www.coreservlets.com/JSF-Tutorial/primefaces/ – PrimeFaces tutorial
http://courses.coreservlets.com/jsf-training.html – Customized JSF and PrimeFaces training courses
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