



# CHAPTER 3

## FORM BEANS



## OBJECTIVES

*After completing “Form Beans,” you will be able to:*

- **Describe the importance of action forms in handling user inputs and HTML form data in the Struts architecture:**
  - How form beans relate to user input and to form output
  - How Struts actions can query and modify action forms
  - How action forms can provide a natural adapter to the model
- **Implement action form classes and configure them to be used with action mappings.**
- **Declare and use dynamic action forms.**

# Working with HTML Forms

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- Another of the common problems tackled by Struts is that of managing HTML forms from JSPs and servlets.
  - Servlets that process HTML form data must repetitively encode the “wiring” from form controls to JavaBean properties – and then often implement the reverse process to populate a form for the response.
  - JSPs get the advantage of `<jsp:setProperty>` and the wildcard feature, but form encoding in the response is still problematic.
  - The raw HTML is a bit troublesome, and requires a careful eye towards maintainability as various fields must be synchronized with bean property names in scriptlet expressions, JSP standard actions such as `<jsp:getProperty>`, or native JSP expressions.
  - There are higher-level tasks, both in receiving and transmitting forms, that could be automated as well.

# Managing Information

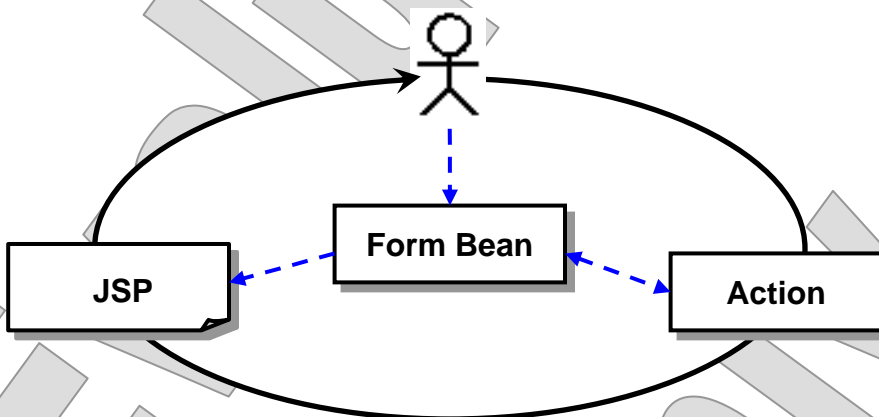
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- More generally, Web applications face the challenge of managing complex sets of information at various scopes and over various durations.
  - Much of this information originates from HTML forms.
  - Some of it is injected into the system from persistent stores or other components, and some of it is derived by the Web application itself.
- How can various controllers and views “see” the information they need, to read or to write, and how can they share a common record of the application’s transient state?

# Form Beans

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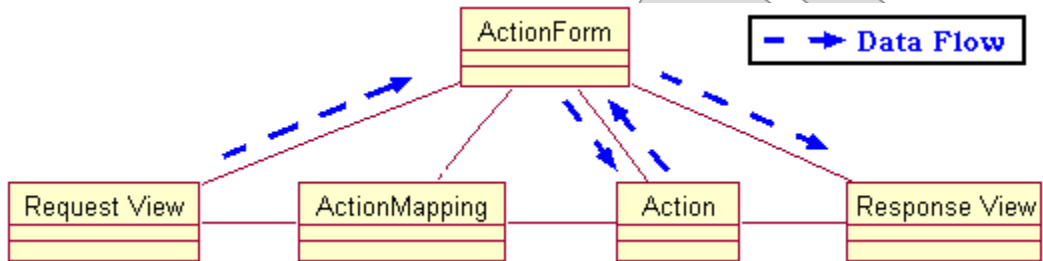
- Struts provides a more elegant solution to these problems using **form beans** – JavaBeans which extend the **ActionForm** class.
- Form beans “glue” the controller to the view in two ways:
  - Manages processing of form input, including optional validation of input values.
  - Manages production of new views populated with values from earlier submissions.
- Thus the form bean becomes a sort of universal bus for data pertaining to a given request/response cycle:



- The transfer of data (shown by dashed blue arrows above) is more or less automatic for different paths, as we'll see.

# The Action Form Class

- At its simplest, an **ActionForm** encapsulates an HTML form and the behaviors surrounding it, and makes it a true class in the application design.



- The developer now treats forms as full-fledged, stateful objects, rather than as flat streams of characters that must be painstakingly managed coming in and going out.
- There are capabilities beyond this, and experienced Struts developers often break the one-to-one relationship of HTML form to action form to take best advantage of the framework.
  - We'll work through progressively more sophisticated uses of action forms and their associated **form beans** throughout the course.

# Declaring an Action Form

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- Action forms are declared in the Struts configuration in a special section `<form-beans>`.
  - Child elements are of type `<form-bean>` and declare a supporting **ActionForm** class.
  - They also give the bean a name for reference elsewhere in the configuration.

```
<form-beans>
  <form-bean name="myData" type="com.my.MyData" />
</form-beans>
```

- An action mapping puts an action form into play by associating it with a particular request URI, controller, and view:

```
<action
  path="/DoSomething"
  type="org.apache.struts.actions.ForwardAction"
  parameter="/Done.jsp"
  name="myData"
  scope="request"
/>
```

- The **name** attribute of the `<action>` element refers to a declared form bean by its name.
- The **scope** attribute then defines either “request” or “session” scope for the bean that will be instantiated.

# Relationship to Input

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- At request time, Struts will assure that an instance of the declared form bean is available to gather request parameters.
  - If the scope is “request”, Struts will use a new bean for each request.
  - If the scope is “session”, all action mappings that make the same name and scope declaration will share a single instance of the bean.
- Struts will transfer information from the HTTP request (CGI string for HTTP GET, message body for HTTP POST) to the bean.
  - For each parameter, it will look for a bean property of the same name.
  - It will then call the mutator method on the bean, converting the argument type to fit the method signature. (That is, if the property is of type **int**, the framework is smart enough to do the **Integer.parseInt** itself, before calling the mutator.)
  - Only certain property types are supported, but the set includes all primitives, their corresponding “box” object types (such as **Integer**), strings, dates, and, most importantly, other JavaBeans.
  - The parameter and property sets needn’t match exactly: parameters for which there is no mutable property will be ignored, and properties for which there is no parameter will be left as they were.

# Relationship to Actions

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- Recall that the action form is passed as a parameter to **Action.execute**.
- Thus the action can query the action form instead of the request itself.
  - This is usually easier and less error-prone.
  - The action can mix and match reading request parameters directly and seeing them through the lens of the action form.
- Action code can also modify the form's properties.
  - This can be an excellent way to **provide information** to the next view in a scenario.
  - For instance, in a multi-page wizard interface, a controller might “fix up” the value of a phone number to include or remove parentheses and dashes as desired.
  - It might fill in **default values** for shipping address based on a user's persistent account information.

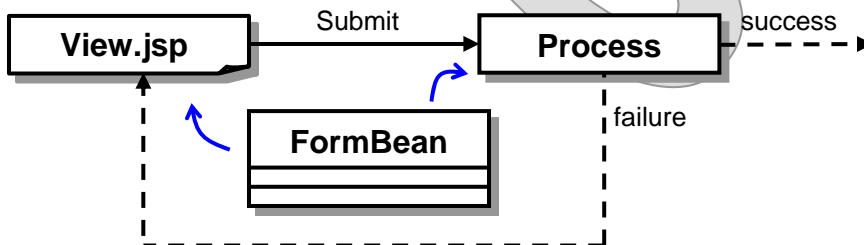
# Relationship to the Model

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- Although they are technically controller components – and should be scrupulously held in that area of the system – form beans provide an excellent point of contact with the model.
  - Very often, the same decomposition into classes that informs the model’s design will make sense in the presentation.
  - Thus form beans will naturally evolve that hold similar information, at a similar granularity, to the business beans that make up part of the model.
- Because an action form needs to offer certain generic behaviors to the framework code, it cannot be just any old JavaBean.
- There are many techniques for sewing the form beans to the business beans, each of which offers a different blend of robustness and coding convenience.
  - Business beans can be exposed as **nested properties** on form beans, so that bean values are found through expressions such as **formBean.value.interestingProperty**.
  - Business beans can be held privately as fields by the form beans, and accessors and mutators can delegate to the business beans.
  - A middle approach is to offer the **value** property on the form bean and to take a snapshot (or to produce one) of the business bean’s values, but not to hold on to the bean itself.

# Relationship to Output

- When a view is finally served as the response, it has access to the form bean and its properties.
- It can produce dynamic values to HTML by a number of techniques:
  - The **Struts HTML tags** automatically find whatever form bean is in play and read from it properties whose names are declared as attributes to the tags themselves.
  - This neatly **combines input and output** in the same tag when building HTML forms: values from the form bean in force when the page is served are pre-populated into the form, and its values are automatically available to the form bean that applies to the next request.
  - **JSP expressions** and **JSTL tags** can read the form bean's properties explicitly, which can be useful at other points in the page where one doesn't want to build a form but just to produce dynamic values.
- We'll consider these in more detail in later chapters.
- One significant consequence of using form beans, then, is that values from a view can be fed back to that view without relying on a preconditioning controller:



- In **Examples/Flow** is a shell application that does nothing but trace the flow of control through the Struts framework.
- **docroot/index.jsp** makes two actions available:
  - One with a simple controller, **cc.struts.Action** – the configuration is shown here:

```
<action
  path="/Action"
  type="cc.struts.Action"
/>
```

- One that uses the same controller and configures a form bean of type **cc.struts.Bean**:

```
<action
  path="/ActionAndBean"
  type="cc.struts.Action"
  name="bean"
  scope="request"
/>
```

- Both Java classes use a third class, **cc.struts.Results**, to trace calls to their constructors and other methods.
- Both actions forward back to **docroot/index.jsp**, which can dump this trace report to the browser.
- Build the application and visit it at the following URL:

<http://localhost:8080/Flow>

- Click the first button to see the creation of the action object and the call to **execute**:

**Flow of Control Example**

Click the buttons below to try out different configurations of action, form bean, and CoR commands. You'll see tracing to the server's standard output which will be echoed in the response page.

Action	Bean	Command(s)	Trace
X		<input type="button" value=".do it"/>	Action created
X	X	<input type="button" value=".do it"/>	Action.execute ()

- Click the same button and notice that the action object is recycled, not created fresh for each request:

Action	Bean	Command(s)	Trace
X		<input type="button" value=".do it"/>	Action.execute ()
X	X	<input type="button" value=".do it"/>	

- Click the second button and observe the sequence of events

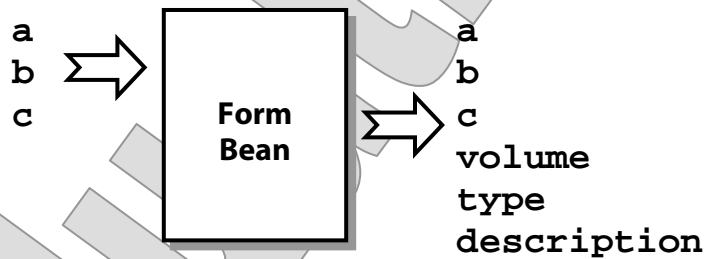
Action	Bean	Command(s)	Trace
X		<input type="button" value=".do it"/>	Bean created
X	X	<input type="button" value=".do it"/>	Bean.setSubmit () Bean.validate () Action.execute ()

- Finally, notice that successive clicks of the second button don't change anything; the form bean is indeed created anew each time.

- **Examples/Ellipsoid/Step2** uses a form bean to communicate between input form and results page.
- Rather than providing a link to the model, this form bean includes the business logic itself.
  - This is not good practice!
  - It's a simple solution for the moment, and later in the course we'll look at a more rigorous implementation that restores the use of the business bean **Ellipsoid** while continuing to use a form bean for fluid communication over a request.
- **Relevant sections of the Struts configuration:**

```
<form-beans>
  <form-bean name="Ellipsoid"
             type="cc.math.EllipsoidForm" />
</form-beans>
...
<action
  path="/Compute"
  type="org.apache.struts.actions.ForwardAction"
  parameter="/Results.jsp"
  name="Ellipsoid"
  scope="request"
/>
```

- At runtime, the parameters **a**, **b**, and **c** as encoded in the HTTP request will be transferred to the corresponding properties on the form bean.
- Then **Results.jsp** simply requests these properties back, plus three new ones, which are the values the user was hoping to calculate.



```
public double getVolume ()
{
    double a = Double.parseDouble (this.a);
    double b = Double.parseDouble (this.b);
    double c = Double.parseDouble (this.c);

    return 4 * Math.PI * a * b * c / 3;
}
```

- Why are **a**, **b**, and **c** defined as **Strings**, rather than using the more natural **double**?
  - Defining them as **doubles** would work, for what we've done so far.
  - We'll talk more later in the chapter about the practice of defining form-bean properties as strings; it has to do with making original input values available for validation.

## Suggested time: 30 minutes

In this lab you will create a Struts action class that does the same data capture that the **periscope** custom tag does at page-production time. This will enable you to snoop on request and session attributes earlier in the request-processing cycle, and this in turn will illustrate a bit more about the Struts framework and how it uses form beans. You will apply your new **Periscope** action to a copy of the Ellipsoid application, and watch Struts work.

It is also possible to skip the coding of the **Periscope** action, and simply to test the answer project, in order to focus on inspecting Struts' use of form beans.

Detailed instructions are found at the end of the chapter.

## **Suggested time: 45 minutes**

In this lab you will revise Love Is Blind to use a form bean to manage the input fields that make up a love note. The resulting application will behave the same way – one slight improvement – but the form bean will provide the basis for later enhancements.

Detailed instructions are found at the end of the chapter.

# Declaring Form Properties

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- Use of a JavaBean can be highly automated.
- Building bean classes in Java can be a repetitive and time-consuming task, however.
  - Especially where the purpose of the bean is not to implement interesting logic around these properties, as it would be for a business bean, the implementations of accessor and mutator methods are usually about identical, except for the property name and perhaps the type.
- Another way to look at this – and it's a happier way by far – is that bean implementation can also be automated.
- Struts facilitates exactly this, by reading `<form-property>` child elements of a `<form-bean>`.

```
<form-bean
  name="myBean"
  type="org.apache.struts.action.DynaActionForm"
>
  <form-property name="height"
                 type="java.lang.String" />
  <form-property name="width"
                 type="java.lang.String" />
</form-bean>
```

- Declaring properties then is as simple as defining **name** and **type** attributes.
- Now, one doesn't have to write the **ActionForm** subclass at all. Instead, declare and use the Struts-implemented **dynamic action form** class.

# The DynaActionForm Class

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- Declare a dynamic form bean by setting its type to **org.apache.struts.action.DynaActionForm**.
- This class implements a dynamic pair of methods **get** and **set**, which are **weakly typed** compared to ordinary action forms and their methods.
  - Each method takes an additional string parameter to replace all the **strongly typed** form-bean methods that would exist otherwise:

```
public Object get (String propertyName);  
public void set (String propertyName, Object val);
```

- It also defines a map of all its values:

```
public Map getMap ();
```

- Although the Struts request processor knows how to use this weakly-typed interface automatically, Java classes and JSPs must use different syntax when using **DynaActionForm**:
  - Java code in action classes must be rewritten to use **get** instead of **getXXX**, **set** instead of **setXXX**.

```
OLD: getAddress ()           NEW: get ("address")
```

- JSPs using Struts custom tags work either way, with no changes, but JSP expressions and JSTL tags need to address a special property **map** to read and write dynamic properties.

```
OLD: ${A.B}                 NEW: ${A.map.B}
```

**Suggested time: 30 minutes**

In this lab you will re-implement **LoveNoteBean** to use **DynaActionForm**. You will do this in two steps: first you will switch to **DynaActionForm** directly, leaving **LoveNoteBean** out of the process; then you will make **LoveNoteBean** subclass **DynaActionForm**, so as to get the declarative properties but still provide the helper method **getLoveNote** that's already in use in the **SendLoveNote** action.

Detailed instructions are found at the end of the chapter.

Evaluate Only

# Validation

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- **Form beans are the basis of input validation in Struts.**
  - **ActionForm** defines a method **validate** which can be implemented by subtypes.
  - Form beans are the natural place for data validation, as they encapsulate validation behavior with the target state.
- **We'll take a close look at validation later on, but a synopsis of the process follows – and you can review **Examples/Flow/Step1** to see some of this process:**
  1. Struts processes a request via the **ActionServlet** – which actually delegates to another class, the **RequestProcessor**.
  2. If a form bean is involved, it is instantiated (if necessary) and automatically populated.
  3. Then the request processor calls the form bean's **validate** method.

```
public ActionErrors validate  
    (ActionMapping mapping,  
     HttpServletRequest request);
```
  4. If the returned **ActionErrors** reference is null or an empty collection, processing proceeds to the action; otherwise it is automatically routed to a path defined in the action mapping by the **input** parameter.
- **The Struts Validator extends this framework by hooking into validation rules declared in XML.**

# Strong Typing?

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- JavaBeans can expose properties of any Java type.
- Struts officially supports a subset of possible types, including primitives, strings, dates, and other beans.
- Practically speaking, though, only strings and booleans are reliable for read/write properties on form beans.
- Why?
- The request processor populates a bean before it validates the bean.
  - Population must succeed, and so many invalid values will be converted by “best effort” to default values such as zero or false.
  - Validation allows an application to address these invalid values by providing clear feedback to the user – but only if it gets a chance to see them!
- If we use non-String types for properties that absorb form input, invalid values will often be lost before we can inspect them.
  - This can result in unclear error messages.
  - Or, worse, it can allow incorrect but technically valid values to flow into the application for processing.

# Form Bean Design

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- As a result, form beans declare properties that are meant to interact with HTML forms as simple strings, booleans, or nested bean types.
  - Thus the relationship with input and output data is a bit dumbed-down – weakly typed.
- Form beans can still expose properties of other types for use by controller components, and that interact with model components.
  - The classic strategy uses **helper properties** that are for use only in action classes or by other beans.
  - Often these helpers are backed by the same physical state: a property **size** might coexist with **sizeAsInt**, each functioning as a different window on the same Java field. (A mini-MVC system!)
  - Care should be taken with names so that the Struts framework is never put in a position to mistake a helper function as the target for HTTP data transfer.

# Coarse-Grained Action Forms

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- Although at first a one-to-one relationship between HTML forms and form beans seems most natural, after a while one looks up and notices that there's no rule against assigning multiple actions to one bean.
  - Especially where **multiple HTML pages** and forms are presented to the user to assemble what the application sees as one logically-related data record, one form bean per form is architecturally limiting.
  - On the flip side, an important limitation does exist: there can be no more than **one form bean per action mapping**.
  - When the form in question is submitting some values that belong on a certain form bean, but also provides other values, practically speaking these must be captured on that form bean, or be relegated to raw HTTP request parameters.
- These forces drive Struts development towards a strategy that uses **coarse-grained** beans.
  - Multiple actions and pages share the semantics of a **single bean** class, whether static or dynamic.
  - They may also share the state of that bean over **multiple requests**, at **session scope**, or they may just use the same type in individual requests.
  - In fact, it's been suggested that all a Struts application really needs is a single form bean, with as many properties as are called for by the union of all HTML forms in the system!

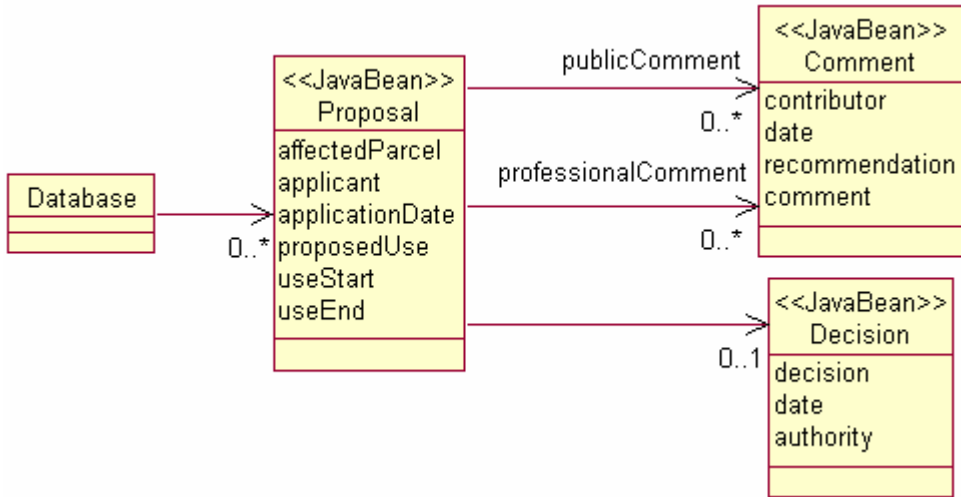
# The reset Method

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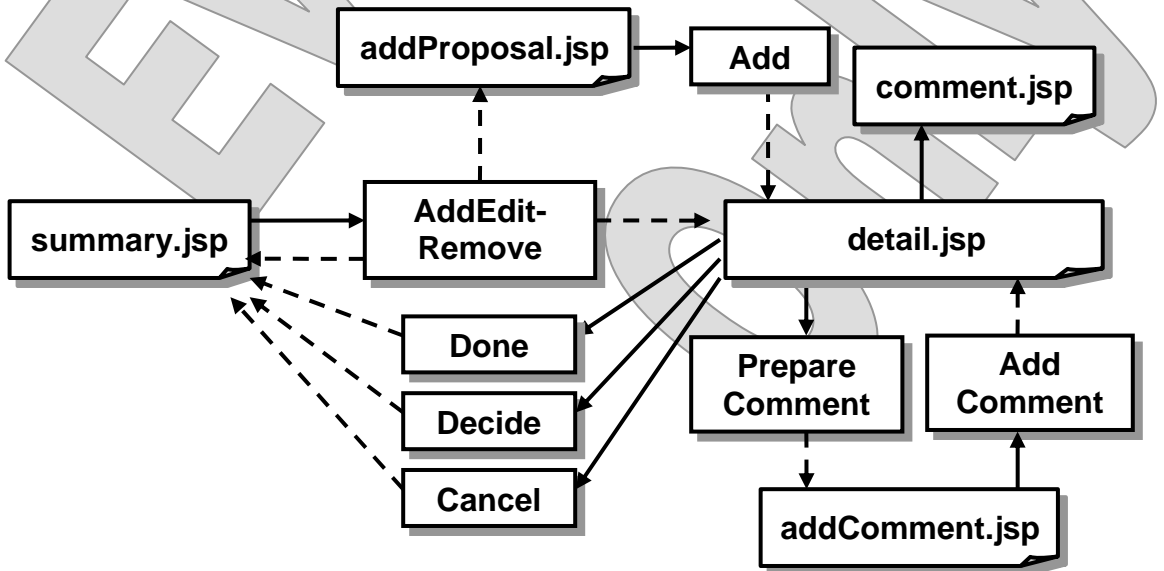
- The method **ActionForm.reset** is called by the request processor just before populating the bean's properties.
  - It will also be called when the bean is first instantiated.
- By default, the method does nothing.
- It is usually not necessary to implement **reset**.
  - For a request-scope bean it may be useful to set a default value here or there.
  - For a session-scoped bean it can be implemented to clear “junk” state that should be re-populated by each request. We'll see an example of this in a moment.
- Do not implement **reset** to clear all state for a session-scope bean.
  - The request processor will call **reset** once per request – regardless of bean scope!
  - If various pages are expecting to share information over the session by way of a form bean, and that form bean's **reset** method alters the information, things will get very tricky.

# The Land-Use Case Study

- In **Examples/LandUse/Step1** is a Struts application that manages a small file of proposals for use of public lands.
- It serves as another case study and illustrates many features of Struts as well as common techniques and best practices.
- A summary diagram of the domain model is shown below.



- The page flow looks like this:



- Build and test the application at the following URL:

http://localhost:8080/LandUse

## USFS Land-Use Proposals

Below is a list of recent and current land-use proposals being considered by the USFS.

Select	Applicant	Parcel	Proposal
<input type="checkbox"/>	Mines-R-Us	Tonto NF	Silver mining
<input checked="" type="checkbox"/>	Cranmore Paper	White Mountains NF	Selective logging
<input type="checkbox"/>	Ski USA	Green Mountain NF	Alpine park

### Proposal

Affected parcel:

Applicant:

Application date:

Proposed use:

Proposed start date:

Proposed end date:

### Public Comments

Contributor	Recommendation
Zeldon Shelbow	<a href="#">Reject</a>

### Staff Comments

Contributor	Recommendation
Lanelle Thompson	<a href="#">Accept</a>

### Decision

Decision: Accepted

Date: 11/30/07

Authority: Jan Landry

- We won't go into much more detail here, but you can explore the remaining few functions and pages of the application yourself, and we'll revisit this example a few more times as we go along.
- A few features of the implementation are worth noting now.
- LandUse employs a very coarse-grained form bean, of type **gov.usda.usfs.landuse.DatabaseWrapper**.

- This one bean holds the entire tree of proposals, decisions, and comments, and can be addressed by various pages using compound property expressions such as

```
DB.selectedProposal.applicant  
DB.possibleDecision.decisionDate.time  
possibleComment.contributor
```

- This is a nice way to minimize the impact of using Struts form beans on a domain model, since only this wrapper class is forced to extend the Struts **ActionForm** class.
- The bean class implements **reset** to clear out its boolean values that model the states of selection checkboxes on the summary page:

```
for (SelectableProposal record : data)  
    record.setSelected (false);
```

- If it didn't do this, selections would accumulate and never be cleared, because HTML checkboxes only produce HTTP request parameters when checked, meaning that Struts would never set a corresponding boolean property to false on its own.

## SUMMARY

- **Action forms provide a sort of data bus to which HTML forms and Struts actions can attach for both input and output.**
  - HTML forms, Struts and JSTL tags and JSP expressions interact with string-type JavaBeans properties.
  - Actions can use more sophisticated property types, as well as ordinary (non-JavaBeans) methods.
- **Form beans are controller components, closely aligned with actions themselves.**
- **They are also a natural point of implementation for adapting business beans in the Struts model.**
  - We've considered a few of the more straightforward strategies for establishing fluid transfer of information between form beans and business beans.
  - Later in the course we'll look at a few more, and especially consider a reflection-based approach facilitated by one of the Struts utility classes.
- **Coarse-grained form beans are a preferred practice, as they facilitate greater and easier information sharing and impose no performance or design penalty.**