# Spring MVC

# Spring MVC Outline

- Overview of MVC paradigm
- The components of Spring MVC
- MVC and Dependency Injection
- Implementing a basic Controller
- Creating a simple View
- Configuring a Spring MVC application
  - Configuring URL mappings
  - Mapping views
- Grouping request handling logic with MultiActionController
- Handling form posts
  - Adding validation
  - Using data binding
  - Adding error reporting
  - Configuring form and success views

# MVC Overview

MVC = Model-View-Controller

Clearly separates business, navigation and presentation logic

Proven mechanism for building a thin, clean web-tier

# MVC Components

Three core collaborating components

- Controller
  - Handles navigation logic and interacts with the service tier for business logic
- Model
  - The contract between the Controller and the View
  - Contains the data needed to render the View
  - Populated by the Controller
- View
  - Renders the response to the request
  - Pulls data from the model

# Motivation for MVC

- Eases maintenance burden
  - Changes to business logic are less likely to break the presentation logic
  - Vice versa
- Facilitates multi-disciplined team development
  - Developers can focus on creating robust business code without having to worry about breaking the UI
  - Designers can focus on building usable and engaging UIs without worrying about Java

# Motivation for MVC

- Use the best tool for the job
  - Java is especially suited to creating business logic code
  - Markup or templating languages are more suited to creating HTML layouts
- Ease testability
  - Business and navigation logic are separated from presentation logic meaning they can be tested separately
  - Practically: you can test more code outside the servlet container

# MVC in Spring

- A single **Front Controller** servlet that dispatches requests to individual Controllers
  - Proven pattern shown in Struts and Core J2EE Patterns
- Request routing is completely controlled by the Front Controller
  - Individual Controllers can be used to handle many different URLs
- Controllers are POJOs
- Controllers are managed exactly like any other bean in the Spring ApplicationContext

# Core Components of Spring MVC

- DispatcherServlet
  - Spring's Front Controller implementation
- Controller
  - User created component for handling requests
  - Encapsulates navigation logic
  - Delegates to the service objects for business logic
- View
  - Responsible for rendering output

# Core Components of Spring MVC

`ModelAndView`

- Created by the Controller
- Stores the Model data
- Associates a View to the request
  - Can be a physical View implementation or a logical View name

`ViewResolver`

- Used to map logical View names to actual View implementations

`HandlerMapping`

- Strategy interface used by `DispatcherServlet` for mapping incoming requests to individual Controllers

# MVC and Dependency Injection

All MVC components are configured in the Spring ApplicationContext

As such, all MVC components can be configured using Dependency Injection

Example:

```
<bean id="springCheersController" class="com....web.SpringCheersController">
  <property name="methodNameResolver“ ref=“springCheersMethodResolver"/>
  <property name="service" ref="service"/>
</bean>
```

# Creating a Basic Controller

- Goals
  - Create a thin-wrapper around the business functionality
  - Keep all business processing out of the web tier
  - Handle only navigation logic
- Process
  - Create the Controller class
    - Implement the `Controller` interface
    - Or extend one of the pre-built `Controller` implementations
  - Create a setter to inject the service object
  - Implement the `handleRequest()` method

# Creating a Basic Controller

```
public class BeerListController implements Controller {
    private SpringCheersService service;

    public void setService(SpringCheersService service) {
        this.service = service;
    }

    public ModelAndView handleRequest(
         HttpServletRequest httpServletRequest,
         HttpServletResponse httpServletResponse)
                                        throws Exception {
        List beers = this.service.findAllBeers();
        return new ModelAndView("beerList", "beers", beers);
    }
}
```

View name

Model parameter name

Model parameter

# Creating a Basic Controller

- What did we do?
  - Create a class that implements the `Controller` interface
- What's left?
  - Configure the Spring MVC infrastructure
    - Once per application
  - Configure the Controller
  - Map the Controller to one or more URLs
  - Create a view
  - Map the view name to the view

# Views in Spring MVC

- Extensive support for many different view technologies
  - JSP, JSTL, Velocity, FreeMarker, JasperReports, PDF, Excel
- Views are represented using logical view names which are returned by the Controller
  - Can return an actual `View` class from the Controller if needed

# View Resolution in Spring MVC

View names are mapped to actual view implementations using `ViewResolvers`

`ViewResolvers` are configured in the web-tier `ApplicationContext`

- Automatically detected by `DispatcherServlet`
- Can configure multiple, ordered `ViewResolvers`

# ViewResolver Implementations

- InternalResourceViewResolver
  - Uses RequestDispatcher to route requests to internal resources such as JSPs
  - Model data is placed in request scope for access in the view
- FreeMarkerViewResolver
  - Uses FreeMarkerView to render the response using the FreeMarker template engine
- VelocityViewResolver
  - Uses VelocityView to render the response using the FreeMarker template engine
- BeanNameViewResolver
  - Maps the view name to the name of a bean in the ApplicationContext.
  - Allows for view instances to be explicitly configured

# Creating a View with JSP and JSTL

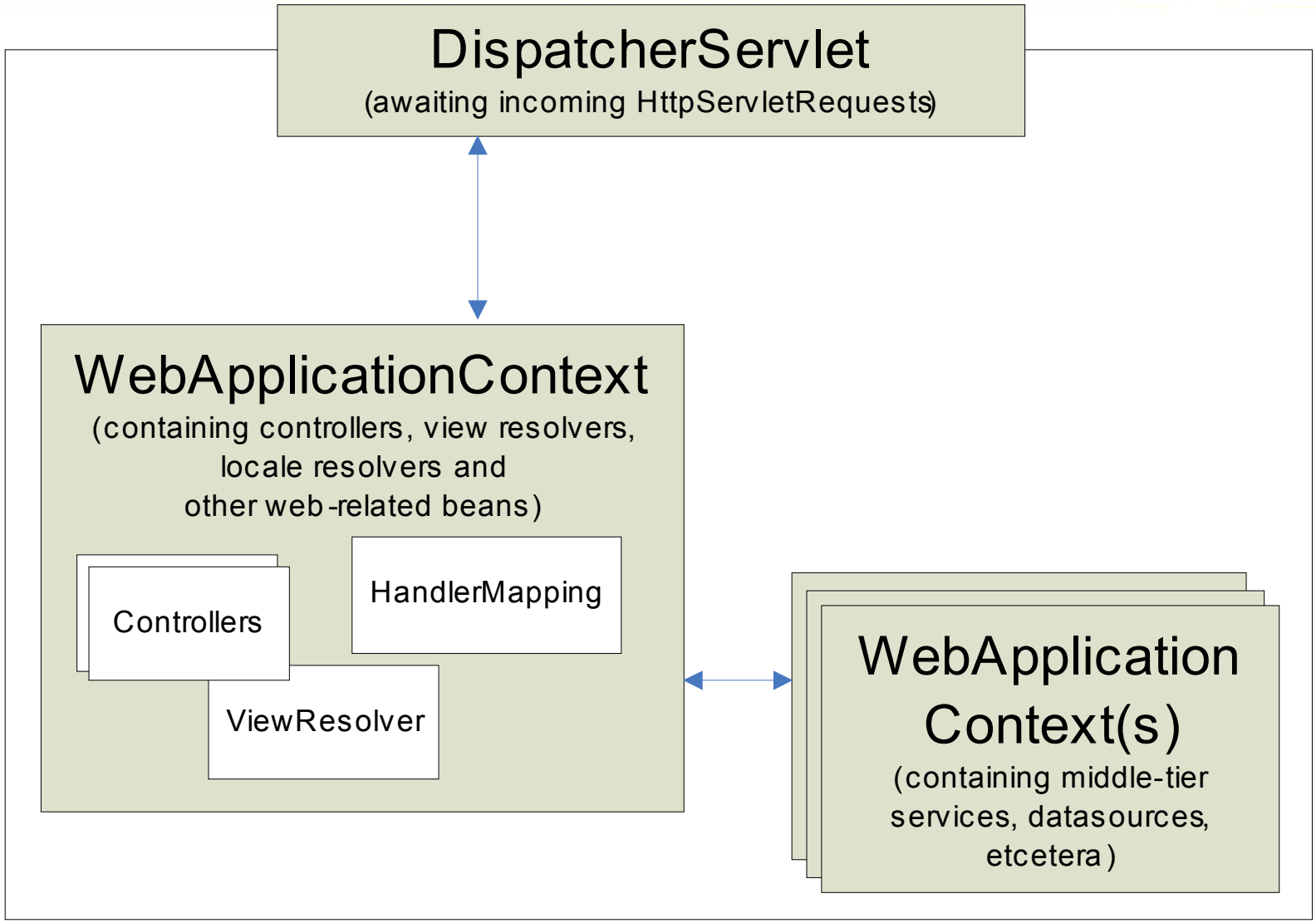
```
<%@ page contentType="text/html;charset=UTF-8" language="java" %>
<%@ taglib uri="http://java.sun.com/jsp/jstl/core" prefix="c" %>
<%@ taglib uri="http://java.sun.com/jsp/jstl/fmt" prefix="fmt" %>

<html>
  <head><title>Beer List</title></head>
  <body>
  <table border="0">
  <c:forEach items="${beers}" var="beer">
    <tr>
      <td><c:out value="${beer.id}"/></td>
      <td><c:out value="${beer.brand}"/></td>
    </tr>
  </c:forEach>
  </table>
  </body>
</html>
```

# Configuring a Spring MVC Application

- Configure the `DispatcherServlet` in web.xml
- Configure `ContextLoaderListener` or `ContextLoaderServlet` to load the business tier and data tier `ApplicationContexts`
- Create the web-tier `ApplicationContext` configuration file
- Configure Controllers
- Map URLs to Controllers
- Map logical view names to view implementations

# Configuring a Spring MVC Application



# Configuring DispatcherServlet

```
<servlet>
   <servlet-name>springcheers</servlet-name>
   <servlet-class>
       o.s.web.servlet.DispatcherServlet
   </servlet-class>
   <load-on-startup>2</load-on-startup>
</servlet>

<servlet-mapping>
   <servlet-name>springcheers</servlet-name>
   <url-pattern>*.htm</url-pattern>
</servlet-mapping>
```

# Configuring ContextLoaderListener

```
<context-param>
   <param-name>contextConfigLocation</param-name>
   <param-value>/WEB-INF/applicationContext.xml</param-value>
</context-param>

<listener>
   <listener-class>
        o.s.web.context.ContextLoaderListener
   </listener-class>
</listener>
```

# Configuring a Spring MVC Application

Creating the web-tier ApplicationContext configuration:

- Naming is important – follows the pattern `/WEB-INF/<servlet_name>-servlet.xml`
- `DispatcherServlet` will automatically load this file when setting up its `ApplicationContext`
- In our example this would be `/WEB-INF/springcheers-servlet.xml`

# Configuring BeerListController

```
<bean id="beerListController"
   class="com.springcheers.web.BeerListController">
     <property name="service" ref="service"/>
</bean>
```

# Mapping URLs to Controllers

Spring from the source

- Mapping request (URLs) to `Controller`
- Controlled by implementations of the `HandlerMapping` interface
- Useful out-of-the-box implementations
  - `BeanNameUrlHandlerMapping`
    - Uses the `Controller` bean name as the URL mapping
  - `SimpleUrlHandlerMapping`
    - Define a set of URL pattern to bean mappings
  - Most out of the box implementations support Ant-style path matching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# Configure a HandlerMapping

```
<bean id="urlMapping"
   class="o.s.web.servlet.handler.SimpleUrlHandlerMapping">
  <property name="mappings">
    <props>
      <prop key="/list.htm">springCheersController</prop>
      <prop key="/view.htm">springCheersController</prop>
      <prop key="/edit.htm">customerForm</prop>
      <prop key="/create.htm">customerForm</prop>
      <prop key="/beer/list.htm">beerListController</prop>
    </props>
  </property>
</bean>
```

# Configuring the `ViewResolver`

```
<bean id="viewResolver"
   class="o.s.w.servlet.view.InternalResourceViewResolver">
     <property name="prefix" value="/WEB-INF/jsp/"/>
     <property name="suffix" value=".jsp"/>
</bean>
```

# Understanding MultiActionController

- One controller to handle different tasks
  - Multiple handler methods
    - Each method handles a different request
  - `MethodNameResolver` determines method
    - Based on parameter or other criteria
  - Can use a delegate to come up with `ModelAndView`
- Good for grouping related tasks into a single class

# Creating a MultiActionController

```
public class SpringCheersController extends MultiActionController {

  private SpringCheersService service;

  /** setter ommitted */

  public ModelAndView handleCustomerList(
           HttpServletRequest request, HttpServletResponse response) {
    return new ModelAndView("customerList",
                                "customers", this.service.getCustomerList());
  }

  public ModelAndView handleViewCustomer(
           HttpServletRequest request, HttpServletResponse response)
                          throws Exception {
    long id = RequestUtils.getRequiredLongParameter(request, "customerId");
    return new ModelAndView("viewCustomer",
                                    "customer", this.service.getCustomer(id));
  }
}
```

# Configuring a MultiActionController

```
<bean id="springCheersController"
   class="com.springcheers.web.SpringCheersController">
  <property name="methodNameResolver"
            ref="springCheersControllerResolver"/>
  <property name="service" ref="service"/>
</bean>

<bean id="springCheersControllerResolver"
   class="o.s.w.servlet.mvc.multiaction.PropertiesMethodNameResolver">
  <property name="mappings">
    <props>
      <prop key="/list.htm">handleCustomerList</prop>
      <prop key="/view.htm">handleViewCustomer</prop>
    </props>
  </property>
</bean>
```

# Unit Testing a Controller

- Test with mock request, response and service
- Glass-box testing
  - Ensure that the service is invoked as desired
  - Fits well with a TDD approach
- Test a variety of interactions
  - Controller with the request and response
  - Controller with the service

# Unit Testing a Controller

```
private SpringCheersController controller;
private SpringCheersService service;
private MockControl serviceControl;

public void setUp() {
  this.controller = new SpringCheersController();
  this.serviceControl =
      MockControl.createControl(SpringCheersService.class);
  this.service =
      (SpringCheersService) this.serviceControl.getMock();

  this.controller.setService(this.service);
}
```

# Unit Testing a Controller

```
public void testHandleViewCustomer() throws Exception{
    MockHttpServletRequest request = new MockHttpServletRequest();
    MockHttpServletResponse response = new MockHttpServletResponse();

    request.addParameter("customerId", "1");

    Customer dummyCustomer = new Customer();
    this.service.getCustomer(1);
    this.serviceControl.setReturnValue(dummyCustomer);
    this.serviceControl.replay();

    ModelAndView mv = this.controller.handleViewCustomer(request, response);

    assertNotNull("ModelAndView should not be null", mv);
    assertEquals("Invalid view name", "viewCustomer", mv.getViewName());

    Customer customer = (Customer)mv.getModel().get("customer");

    assertNotNull("Customer should not be null", customer);
    assertEquals("Invalid customer returned", dummyCustomer, customer);
}
```

# Integration Testing

```
public class BeerListControllerIntegrationTests
                extends AbstractControllerIntegrationTests {
    private BeerListController beerListController;

    public void setBeerListController(BeerListController beerListController) {
        this.beerListController = beerListController;
    }

    public void testListBeers() throws Exception {
        MockHttpServletRequest request = new MockHttpServletRequest();
        MockHttpServletResponse response = new MockHttpServletResponse();

        ModelAndView mv = this.beerListController.handleRequest(request,
   response);

        assertEquals("Incorrect view name", "beerList", mv.getViewName());

        List beers = (List) mv.getModel().get("beers");

        assertNotNull("Beer list not in model", beers);

        int count = jdbcTemplate.queryForInt("select count(0) from beers");
        assertEquals("Incorrect number of beers in list", count, beers.size());
    }
}
```

# Handling Form Posts with SimpleFormController

- Create the custom `SimpleFormController`
- Create the form view
- Adding data binding logic to the form view
- Add error display logic to the form view
- Create the success view
- Define a command object for the form
- Add on submit logic
- Optionally
  - Add validation logic
  - Hook in custom data binding logic

# Request Workflow of SimpleFormController

- GET request displays the form
- POST request submits the form
- Both have distinct workflow
  - GET does not need validation
  - POST does not need form view
  - ...
- Implement template methods to customize behavior

# GET request – Form Display

`formBackingObject()`

- Retrieve the command object
- Allows for pre-population of the form

`initBinder()`

- Register custom editors

`referenceData()`

- Load reference data needed for displaying the form

`showForm()`

- Completes `ModelAndView` and returns
- Command object stored in session if configured
- Renders the actual form

# POST request – form submission

`formBackingObject()`
- Retrieve the command object
  - Maybe from session, maybe from database

`initBinder()`
- Register custom editors
- Binding of request parameters to form

`onBind()`
- Called after bind but **before** validation
- Allows you to manually bind request parameters to the command object before validation

Validation done using `Validators`

`onBindAndValidate()`
- Called after bind and validate
- Allows you to bind parameters to the command that don't need validation

If validation fails then add errors to the `ModelAndView` and show the form again

If validation succeeds call `onSubmit()` callbacks and show the success view

# Creating the Form View

```
<html>
 <head>
  <title>Spring Cheers</title>
 </head>
 <body>
 <h1>Update Customer</h1>
  <form name="editCustomer" method="POST">
   <table border="0">
    <tr>
     <td>Name: </td>
     <td>
        <input type="text" size="30"  name="command.name"/>
     </td>
    </tr>
    <tr>
     <td colspan="2"> </td>
      <td><input type="submit" value="Save"/></td>
    </tr>
   </table>
  </form>
 </body>
<html>
```

# Adding Data Binding to the Form

```
<spring:bind path="command.name">
  <td>
    <input type="text" size="30"
           name="<c:out value='${status.expression}'/>"
           value="<c:out value='${status.displayValue}' />"
    />
  </td>
</spring:bind>
```

# Adding Error Handling to the Form

```
<spring:bind path="command.name">
   <td>
     <input type="text" size="30"
            name="<c:out value='${status.expression}'/>"
            value="<c:out value='${status.displayValue}' />"
     />
   </td>
   <td>
     <c:if test="${status.error}">
       <div class="error">
         <c:forEach items="${status.errorMessages}" var="error">
           <c:out value="${error}"/>
         </c:forEach>
       </div>
     </c:if>
   </td>
</spring:bind>
```

# Creating the CustomerForm Controller

```
public class CustomerForm extends SimpleFormController {

  private SpringCheersService service;

  public void setService(SpringCheersService service) {
    this.service = service;
  }

  protected Object formBackingObject(HttpServletRequest request)
                      throws Exception {
    long id = RequestUtils.getLongParameter(request, "customerId", -1);
    return (id > 0) ? this.service.getCustomer(id) : new Customer();
  }

  protected void doSubmitAction(Object customer) throws Exception {
    this.service.saveCustomer((Customer) customer);
  }
}
```

# Validation Architecture

Not tied to the `HttpServletRequest`

Not tied to the web-tier

- Validation of domain objects
- Input from remote clients also needs validation
- Can easy be tested outside of the container

Implementation independence

Conversion errors are *non-fatal*

- `java.lang.Long` property
  - Typing in nothing (converts to null)
  - Typing in 'foo'
  - No difference with respect to validation!!

# Creating a Validator

```
public class CustomerValidator implements Validator {

  public boolean supports(Class cls) {
    return (cls == Customer.class);
  }

  public void validate(Object obj, Errors errors) {
    Customer customer = (Customer) obj;

    ValidationUtils.rejectIfEmptyOrWhitespace(errors,
                              "name", "required", "required");
  }
}
```

# Configuring the `CustomerForm` Controller

```
<bean id="customerForm"
   class="com.springcheers.web.CustomerForm">
   <property name="formView" value="editCustomer"/>
   <property name="successView" value="redirect:list.htm"/>
   <property name="service" ref="service"/>
   <property name="validator" ref="customerValidator"/>
</bean>
```

# Summary

Spring MVC provides a sophisticated MVC implementation

- Interface-based for easy testing
- Fully integrated with Spring IOC
- Comprehensive view technology integration
  - JSP & JSTL
  - Velocity
  - FreeMarker
  - PDF
  - Excel