Spring Web Flow
Dialogs for the Web

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In the Next 60 Minutes…

You will learn how to orchestrate controlled web application conversations using Spring Web Flow.

Agenda

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Problem

Web applications are a mixed bag

- Consist of free navigations
  - Browsing a product catalog
  - Viewing product details
- And controlled page flows
  - Completing a checkout process
  - Applying for store credit

Free Navigation

Characteristics

- A set of pages connected by links
- Each link accesses a public resource
  - http://www.spring-shoes.com/catalog
  - http://www.spring-shoes.com/catalog/nb/476
- Users have access to each link freely
  - Links are often bookmarked
- **There is no controlled page flow**
- **There is no task to complete**

Controlled Page Flow

Characteristics

- A user task consisting of multiple steps
  - Has a starting point
  - Usually has an ending point
- Each task is accessible as a public resource
  - http://www.spring-shoes.com/checkout
- A task guides a single user toward completion of a business goal
- The progress of one user's task execution is independent of other users

DEMO

Real-world examples

Controller Characteristics

Free vs. controlled navigation

- A free navigation controller is simple
  - Stateless
  - Renders the view of a resource when requested
  - Existing frameworks do a good job here
- A controlled page flow controller is more complex
  - Stateful
  - Orchestrates a task with a linear progression
  - Renders views as necessary to allow the user to participate in the task
  - Not the focus of most existing frameworks

Controlled Navigation Challenges

What is traditionally difficult

- Enforcing a linear progression
  - Preventing the user from jumping around
  - Preventing the same task from being completed twice
- Managing state
  - Storing and accessing task state
  - Cleaning up the state of ended or expired tasks
  - Keeping server state in sync with the client
  - Preventing server state from being overwritten by other tasks executing in parallel

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Enforcing a Linear Progression

Conventional approach

- The client drives the progression
  - Navigation hints are often embedded in URLs
    - `order.do?_currentPage=3`
    - `order.do?_finish=true`
- The controller validates that the client does the right thing according to the flow navigation rules
  - Figures out what step the client says she is at
  - Ensures task steps are executed in the correct order

DEMO

Enforcing a linear progression

Conventional

Enforcing a Linear Progression

Conventional implications

- The client can attempt to short-circuit the flow
  - Maliciously or accidentally
    - `order.do?_confirmed=true`
- The controller must prevent this
- As a result both the client and controller are often aware of flow navigation rules
- This often leads to:
  - Hard coded navigation hints in your JSPs
  - Many if/else statements within your controller implementation

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Enforcing a Linear Progression

Spring Web Flow approach

- The controller drives the progression not the client
- The client simply provides the controller input when asked
  - **Client is not navigation rule aware**

```
client: start task
server: start; process input; render the starting form
client: submit
server: resume; process input; render the next form
client: submit
server: resume; finish; render confirmation
```

DEMO

Enforcing a linear progression

Spring Web Flow

Enforcing a Linear Progression

Spring Web Flow benefits

- The client can not short-circuit the flow
  - She can only provide the flow input from a specific point when asked
- The controller always knows what step the client is at
  - You no longer have to figure this out
  - You get a callback to resume processing from the correct point
- All flow navigation rules are encapsulated within the controller
  - Changing navigation rules does not impact clients

Managing State

Conventional approach

- The controller is stateless
- Stores task context in the session
- Cleans up context in the session after task completion
- Manages a session token to prevent completing the same task execution more than once

Code Sample

```
public Forward onFormSubmit(HttpServletRequest request) {
    if (isStartRequest(request)) {
        assertTaskNotInProgress(request);
        createTaskContext(request);
        return startingForm(request);
    } else if (isResumeRequest(request)) {
        assertSessionToken(request);
        if (isCurrentForm(request)) {
            updateSessionData(request);
            return errors(request) ? currentForm(request)
                   : nextForm(request);
        } else {
           return handleOutofSyncSubmit(request);
        }
    } else if (isFinishRequest(request)) {
        assertSessionToken(request);
        processSubmit(request);
        cleanupSessionData(request);
        removeSessionToken(request);
    }
}
```

Managing State

Conventional implications

- Use of the back button refers to session state captured at later point
- Opening a new window overwrites the other window's data
- Not properly cleaning up after task completion brings consequences
  - Memory leaks
  - Duplicate submission
  - Including stale data in a new task execution
  - Flow short circuit

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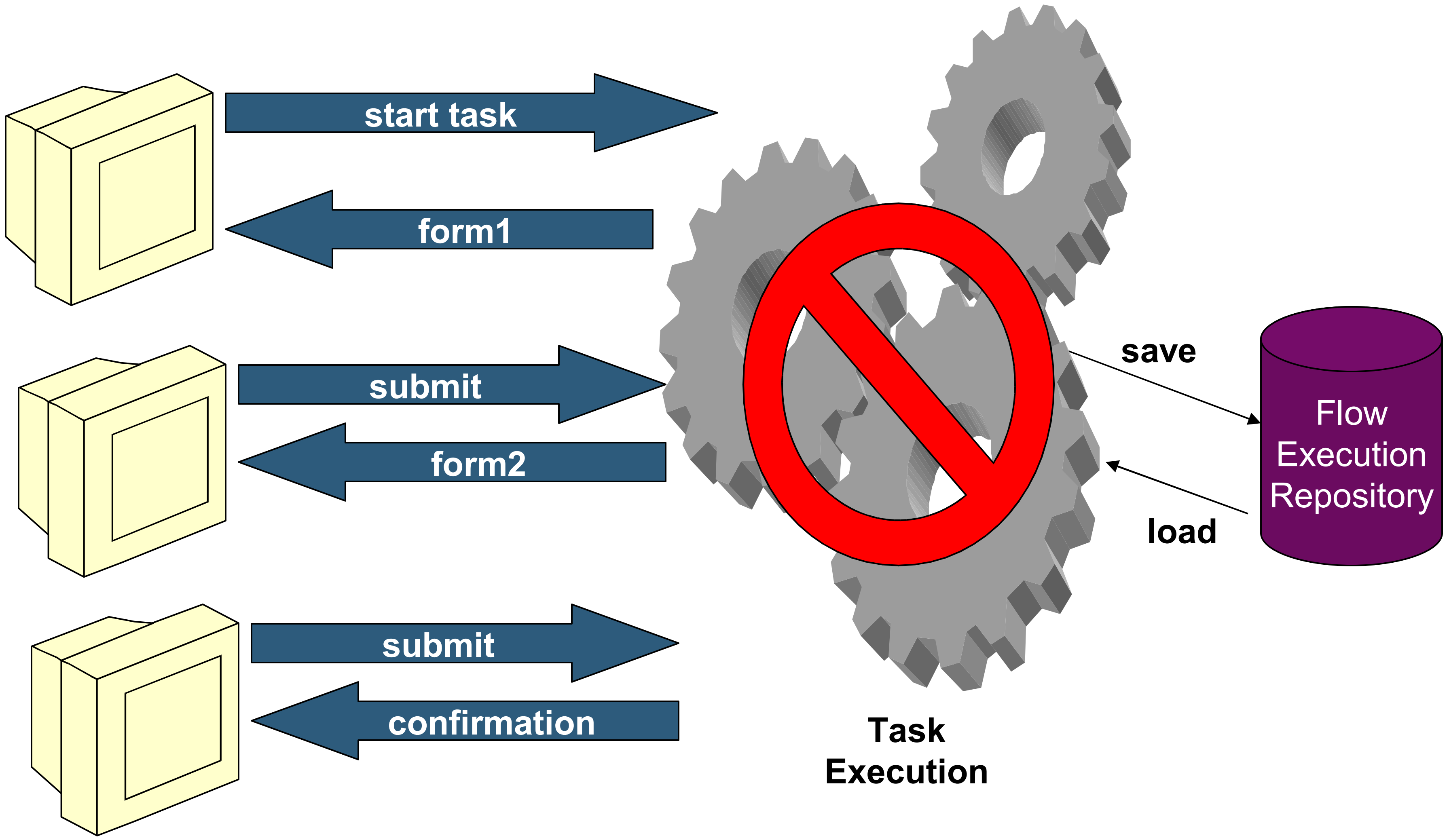
Managing State

Spring Web Flow approach

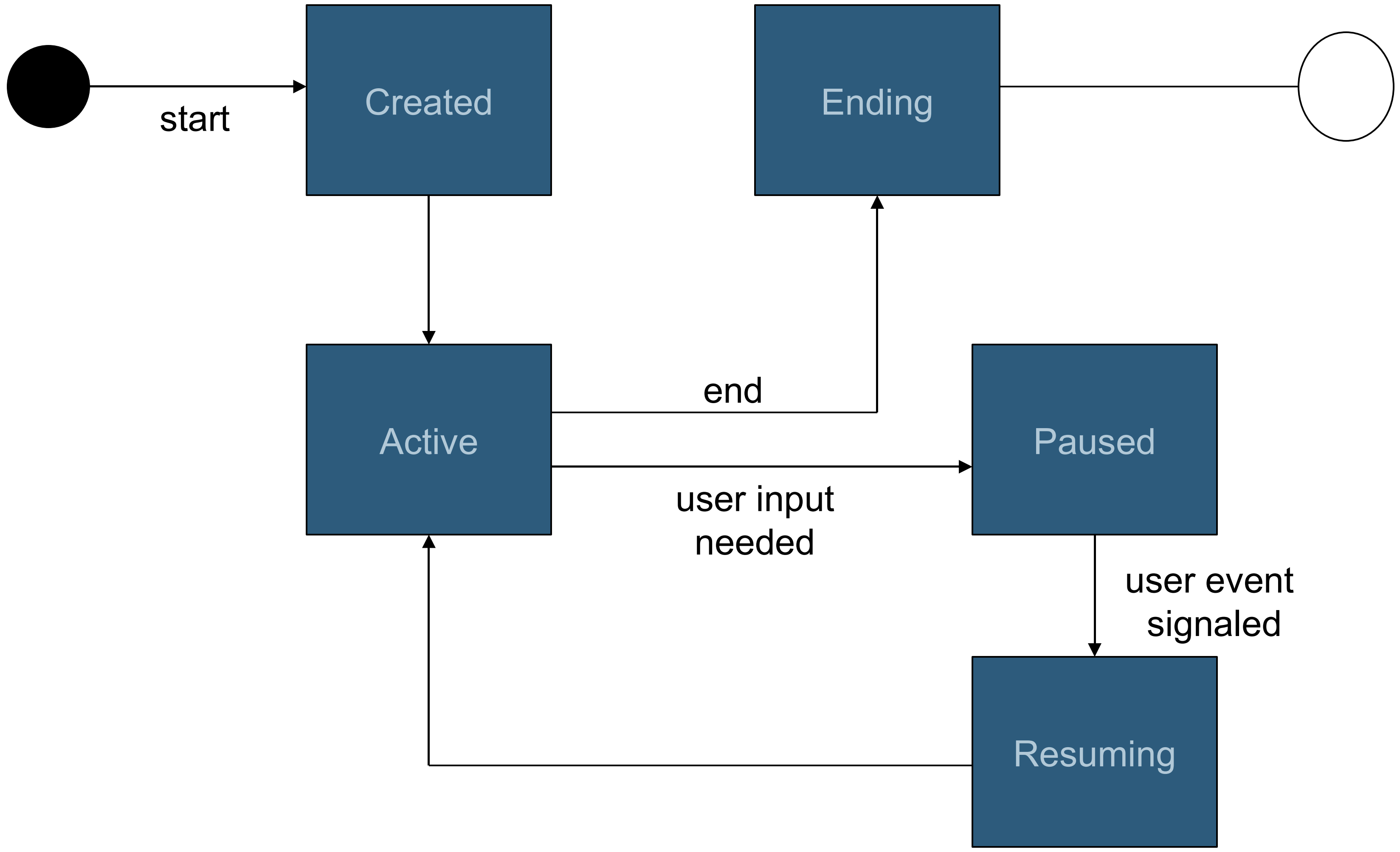
- The controller is stateful
  - Represents an executing task at a point in time
- Stored in a repository between requests
- Clients resume the controller to continue task execution from a point in time


start task
form1
submit
form2
submit
confirmation
save
load
Flow Execution Repository
Task Execution

Managing State

Spring Web Flow benefits

- Use of the back button refers to the state of the task execution at that point in history
- Opening a new window clones an independent task execution at the current step
- When a task completes it is purged from its repository
  - All managed state is eligible for garbage collection
  - It is impossible to continue a task that has completed


start
Created
Ending
Active
end
user input needed
Paused
user event signaled
Resuming

Approach Summary

Spring Web Flow vs. Conventional

- One controller, the flow, drives the entire task execution
- The flow pauses when client input is required
- The flow resumes when client input is provided
  - Initiated by an event
- Event processing logic is encapsulated within the flow
  - Client has no knowledge of flow navigation rules
    - Can only influence navigation via an event model, can not drive navigation

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Flow Definition

How do you define a flow?

- You use a domain-specific language (DSL)
  - XML form is most popular

XML Representation

```
<flow start-state=“step1”>

    <my-state id=“step1”>
        <transition on=“event” to=“step2”/>
    </my-state>

    <my-state id=“step2”>
        <transition on=“event” to=“finish”/>
    </my-state>

    <end-state id=“finish”/>

</flow>
```

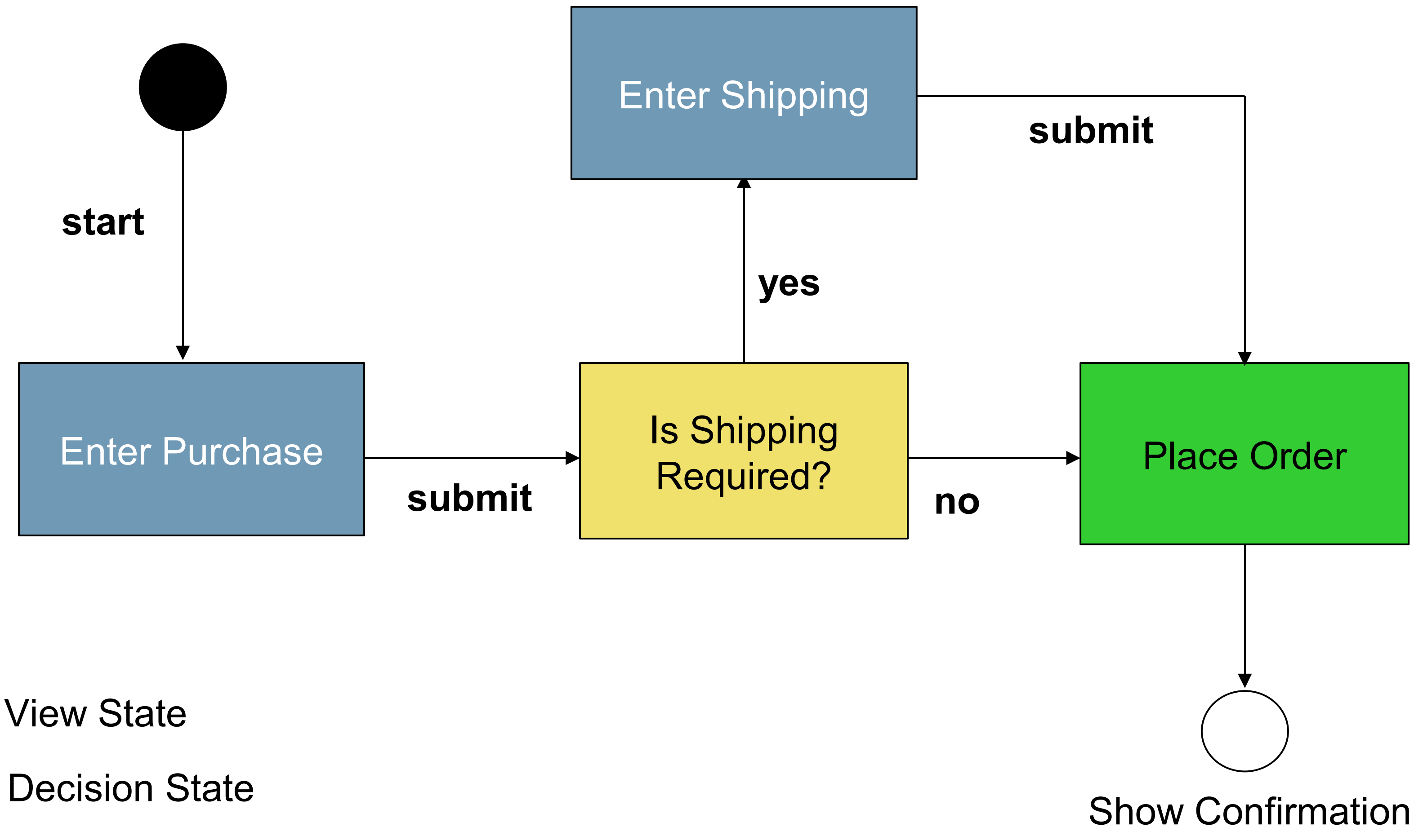
Flow Builder API

```
FlowBuilder builder = new AbstractFlowBuilder() {
    protected void buildStates() {
        addMyState(“step1”, on(“event”, to(“step2”));
        addMyState(“step2”, on(“event”, to(“finish”));
        addEndState(“finish”);
    }
}
FlowAssembler assembler =
    new FlowAssembler(“myFlow”, builder);
assembler.assembleFlow();
Flow flow = builder.getResult();
```

Flow Definition

Characteristics

- Declarative instructions to an execution engine
- A set of states that you define
- Each state executes a behavior when entered
  - View states solicit user input
  - Action states execute commands
  - Decision states make routing decisions
  - Subflow states spawn child flows
  - End states terminate flows
- Events you define drive state transitions
  - Transitions define the paths through the flow



🟦 View State

🟨 Decision State

🟩 Action State

○ End State

```
<flow start-state="enterPurchase">

    <view-state id="enterPurchase" view="purchaseForm">
        <transition on="submit" to="shippingRequired">
            <action bean="form" method="bindAndValidate"/>
        </transition>
    </view-state>

    <decision-state id="shippingRequired">
        <if test="${purchase.shipping}"
            then="enterShipping" else="placeOrder"/>
    </decision-state>

    <action-state id="placeOrder">
        <action bean="orderClerk"
                method="placeOrder(${purchase})"/>
        <transition on="success" to="showConfirmation"/>
    </action-state>

    <end-state id="showConfirmation" view="confirmation"/>

    <import resource="purchase-flow-beans.xml"/>

</flow>
```

Bean id to Implementation Binding

```
purchase-flow.xml
<action bean="orderClerk"
        method="placeOrder(${purchase})"/>


purchase-flow-beans.xml
<beans>
    <bean id="orderClerk" class="example.StubOrderClerk"/>
</beans>
```

- Spring Web Flow can bind to any method on any object:

```
public interface OrderClerk {
    OrderConfirmation placeOrder(Purchase purchase);
}
```

...Without your object depending on SWF APIs

Flow Definition

Benefits

- One artifact defines all task controller logic
- Is abstract; not concerned with:
  - State management
  - Servlet or Portlet APIs
  - URLs
  - Back button
  - Malicious clients
- The execution system cares for those concerns
- **A flow definition defines a task executable in any environment**

DEMO

The same flow executing within a Servlet and Portlet environment

Steps to Flow Execution

Readying a flow for execution

- Deploy your flow definitions to a registry:

```
<beans>

    <xmlFlowRegistry id="registry"
         flowLocations="/WEB-INF/flows/**/*.xml"/>

    …

</beans>
```

- By default a flow is assigned a registry identifier by convention
    - `purchase-flow.xml` becomes `purchase-flow`

Steps to Flow Execution

Readying a flow for execution

- Configure the flow executor for the environment you are running in
  - Spring MVC, JavaServer™ Faces, Struts supported out-of-the-box
- (Optional) Configure a strategy for how flow executions will be persisted between requests
  - In the session
  - To the client
- (Optional) Configure how flow executor arguments are extracted from the request
  - From request parameters
  - From the request path

Spring MVC Flow Executor

```
<beans>

    <flowController name="/*"
         registry-ref="registry"
         storage="client"
         argumentExtractor="requestPath"/>

</beans>
```

- Exposes flows in the registry for execution
- Uses request path parameterization to launch new flow executions
  - http://localhost/app/purchase
  - http://localhost/app/credit

Registry identifier

Flow Execution Rendering

Requirements

- View selections made by your flows must be resolvable to a response writer
- Typically a view template
    - Template resolution is handled by the framework SWF is integrating with
        - ViewResolver (Spring MVC)
            - Supports JavaServer Pages™ technology, Velocity, Freemarker, and custom views
        - Action forward (Struts)
        - View Name (JavaServer Faces technology)
- View templates must output the flow execution key to support a resume operation on submit

Example Template (JSP™ Technology)

```
<form method="post" action="${flowUrl}">
  …
  <spring-webflow:flowExecutionKey/>
  <input type="submit" name="_eventId_submit"
                       value="Submit">
</form>
```

- Flow execution key identifies a FlowExecution in the repository
  - Continues the conversation from the `view-state` that selected this view
- Event id communicates what user action occurred
  - Drives a transition out of the current `view-state`

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Integrating Into Other Frameworks

Through an adaption layer

- Struts
  - FlowAction executes all flows
  - View selections are mapped to action forwards
  - An action form adapter allows SWF data binding
- JavaServer Faces platform
  - FlowPhaseListener restores flow executions from the repository on “restore view” phase
  - JSF components resolve flow expressions
    - Via FlowVariableResolver and FlowPropertyResolver
  - FlowNavigationHandler continues flows
- **Spring Web Flow is positioned as an embeddable page flow engine**

JavaServer Faces Integration Example

```
<faces-config>
    …
    <navigation-handler>
        o.s.webflow.executor.jsf.FlowNavigationHandler
    </navigation-handler>
    <property-resolver>
        o.s.webflow.executor.jsf.FlowPropertyResolver
    </property-resolver>
    <variable-resolver>
        o.s.webflow.executor.jsf.FlowVariableResolver
    </variable-resolver>
    …
    <phase-listener>
        o.s.webflow.executor.jsf.FlowPhaseListener
    </phase-listener>
    …
</flow>
```

JavaServer Faces Integration Example

- **Launching a flow as a command link**

```
<h:commandLink value="Go" action="flowId:myflow"/>
```

- **Resuming a flow with component binding expressions**

```
<h:form id="form">
    ...
    <h:inputText id="propertyName"
       value="#{managedBeanName.propertyName}"/>
    ...
    <h:commandButton type="submit" action="submit"/>
</h:form>
```

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Future

Spring Web Flow roadmap

- Nested, parallel flow executions
- JMX™-based flow execution management
  - Monitor in-flight conversations
- Conversation history subsystem
  - To support bread crumbs, statistics
- More integration
  - Tapestry
  - Business process management (BPM)
  - Acegi Security
  - Persistence providers (Session per flow)
  - Others?

Getting Started

Spring Web Flow jumpstart

- Access http://www.springframework.com/download
- Download Spring Web Flow 1.0 RC2
- Extract zip archive
- CD to `projects/build-spring-webflow`
- Execute `ant samples` to build sample apps
- Deploy sample .WARs for evaluation
  - Each sample is importable as a Eclipse project for easy review

Additional Resources

Spring Web Flow Related

- Reference and API documentation
  - http://www.springframework.org/documentation
- Support forum
  - http://forum.springframework.org
- Books
  - Expert Spring MVC and Web Flow, Apress
- Confluence Wiki
  - http://opensource2.atlassian.com/confluence/spring/display/WEBFLOW

Q&A

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