Overview of POJO programming

A simpler, faster way to build long-lived applications

by

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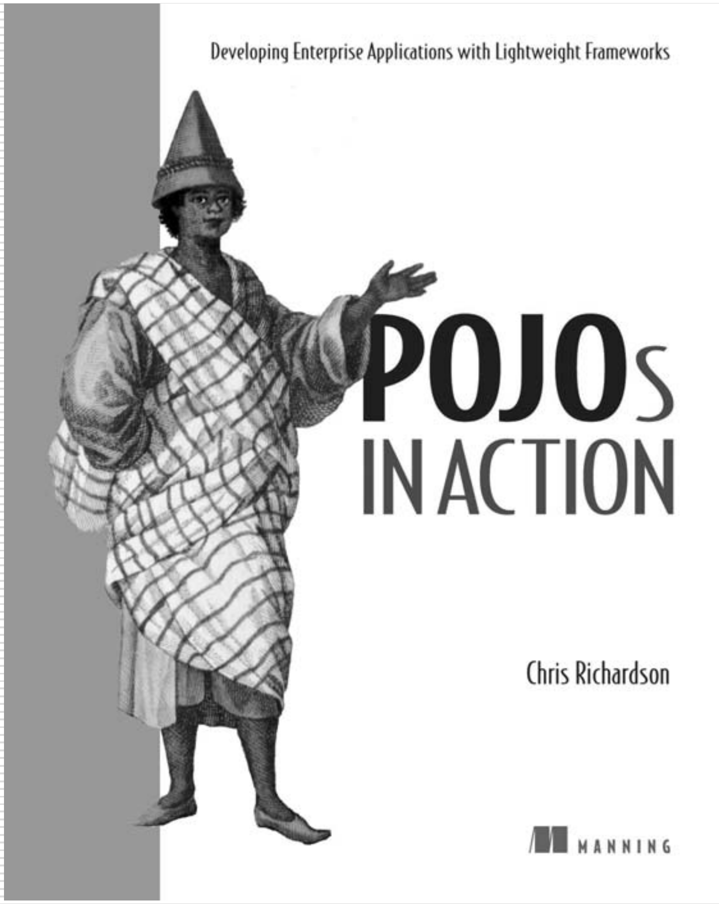
About Chris…


Developing Enterprise Applications with Lightweight Frameworks
POJOs
IN ACTION
Chris Richardson
MANNING

- Grew up in England
- Live in Oakland
- Twenty years of software development experience
  - Building object-oriented software since 1986
  - Using Java since 1996
  - Using J2EE since 1999
- Author of POJOs in Action
- Run a consulting company that helps organizations build better software faster
- Chair of the eBIG Java SIG in Oakland (www.ebig.org)

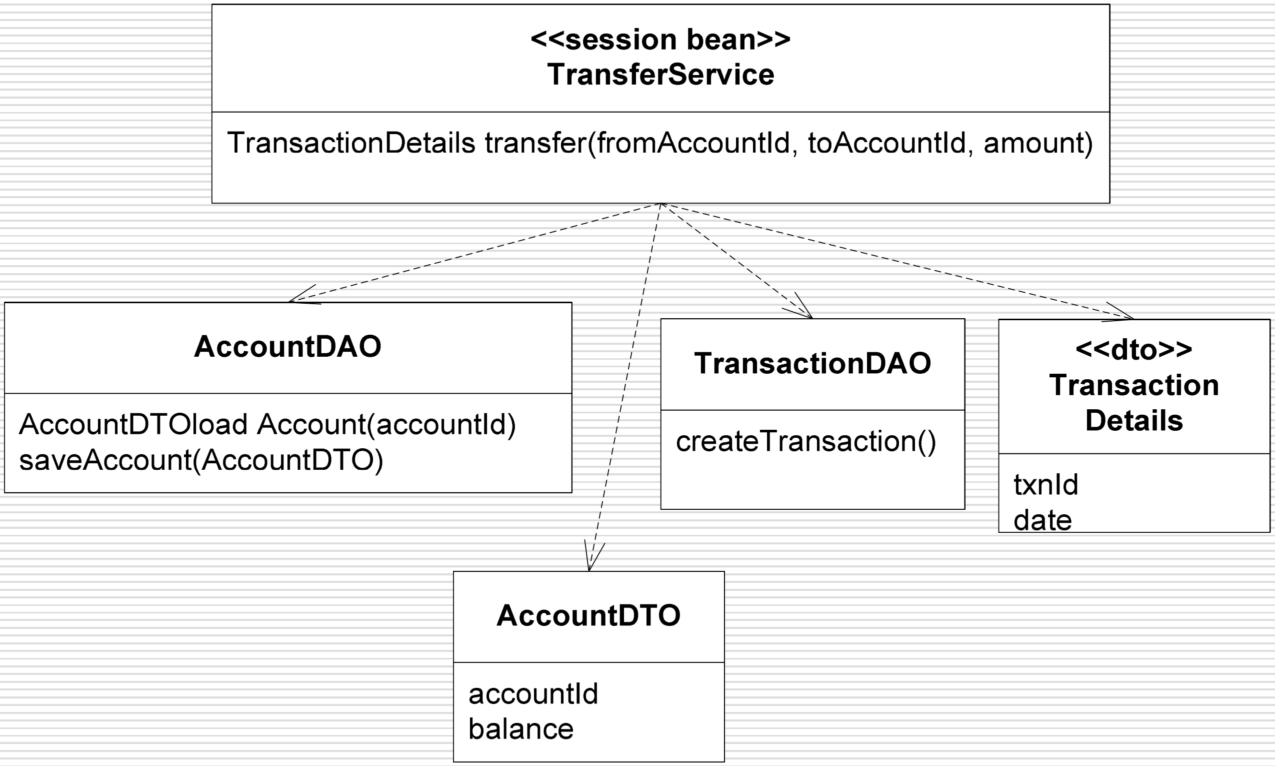
Overview

- POJOs + lightweight frameworks:
  - Simplify development
  - Accelerate development
  - Make applications immune to the volatility of enterprise Java technology
- Focus on the “backend” frameworks:
  - Business tier
  - Database access tier

Agenda

- The trouble with traditional enterprise Java frameworks
- Overview of POJOs
- Assembling POJO applications with dependency injection
- Persisting POJOs with Hibernate
- Making POJOs transactional with Spring

Classic EJB architecture example



<<session bean>>
TransferService

TransactionDetails transfer(fromAccountId, toAccountId, amount)

AccountDAO

AccountDTOload Account(accountId)
saveAccount(AccountDTO)

TransactionDAO

createTransaction()

<<dto>>
Transaction Details

txnId
date

AccountDTO

accountId
balance

Problems with intertwined business logic and infrastructure

- Upgrading to new, better version of infrastructure framework is difficult/impossible:
  - Enterprise Java (1998-2006):
  - Incompatible standards: EJB 1, EJB 2, EJB 3
  - Many persistence options: EJB CMP 1/2, Hibernate 1/2/3, JDO 1/2, EJB 3 persistence
- Makes development more difficult
  - Forced to think about business logic + infrastructure concerns simultaneously
  - Developers need to know both

…problems

- Makes testing more difficult
  - Must deploy code/tests in application server
  - Slows down the edit-compile-debug cycle
- EJB 2 prevented OO development
- EJB application servers are
  - Complex
  - Expensive (some)

EJB as a cult

- In 1999 I readily embraced EJBs and its development rituals:
  - writing DTOs and unused lifecycle methods
  - Waiting for EJBs to deploy
- According to http://en.wikipedia.org/wiki/Cult

“a **cult** is a relatively small and cohesive group of people devoted to beliefs or practices that the surrounding culture or society considers to be far outside the mainstream”

- But there is a better way….

Agenda

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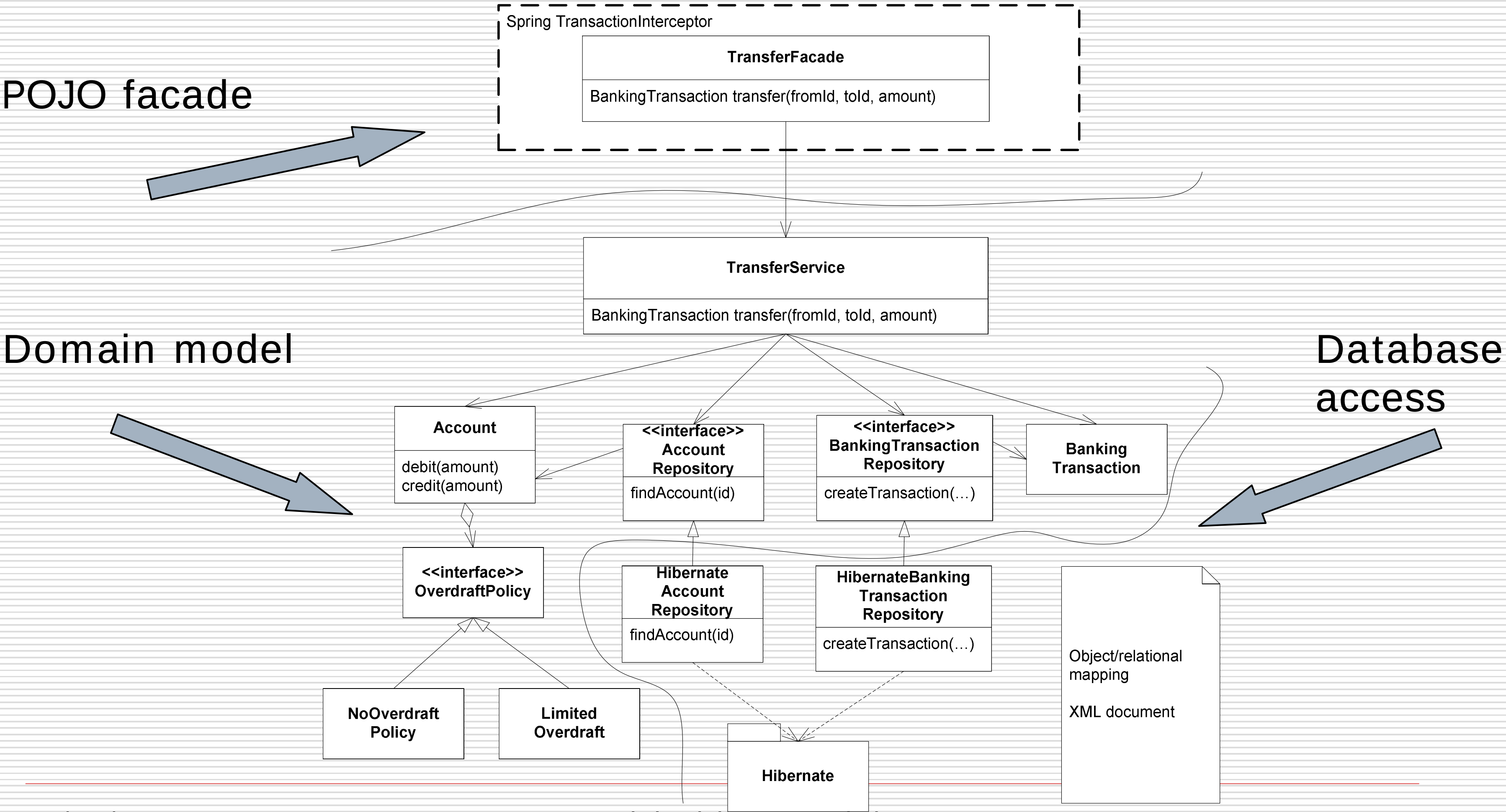
- ➢ **Overview of POJOs**
- □ Assembling POJO applications with dependency injection
- □ Persisting POJOs with Hibernate
- □ Making POJOs transactional with Spring

POJO = Plain Old Java Object

- Java objects that don't implement any special interfaces or (perhaps) call infrastructure APIs
- Coined by Martin Fowler, Rebecca Parsons, and Josh MacKenzie to make them sound just as exciting as JavaBeans, Enterprise JavaBeans
- Simple idea with surprising benefits

POJO application design



POJO facade

Domain model

Database access

Spring TransactionInterceptor
TransferFacade
BankingTransaction transfer(fromId, toId, amount)
TransferService
BankingTransaction transfer(fromId, toId, amount)
Account
debit(amount)
credit(amount)
<<interface>> Account Repository
findAccount(id)
<<interface>> BankingTransaction Repository
createTransaction(…)
Banking Transaction
<<interface>> OverdraftPolicy
Hibernate Account Repository
findAccount(id)
HibernateBanking Transaction Repository
createTransaction(…)
Object/relational mapping
XML document
NoOverdraft Policy
Limited Overdraft
Hibernate

POJO code example

- Simple Java classes
- No lookup code – uses dependency injection instead

But POJOs are insufficient… ⇒ Lightweight frameworks

- □ Endow POJOs with enterprise features
- □ Object/relational mapping framework:
  - ■ Persists POJOs
  - ■ JDO, Hibernate, JPA, …
- □ Spring framework:
  - ■ Popular open-source framework
  - ■ Declarative transaction management
  - ■ Dependency injection
  - ■ Remoting, security, …

Key point: non-invasive frameworks

- Provide services without the application:
  - Implementing interfaces
  - Calling APIs
- Configured using metadata:
  - XML
  - Java 5 annotations
- POJOs + non-invasive frameworks ⇒ simple, faster development of applications that are immune to infrastructure changes

Deployment options

- Web container-only server
  - Tomcat or Jetty
  - Simple yet sufficient for many applications
- Full-blown server
  - WebLogic, JBoss, WebSphere
  - Richer set of features
  - Enhanced manageability and availability
  - JTA
  - JMS
  - ...

Benefits of using POJOs

- Separation of concerns
  - Business logic is decoupled from infrastructure
  - Switch frameworks or upgrade more easily
  - Not everybody has to be an infrastructure framework expert
- Simpler development
  - Think about one thing at a time
  - Business logic, persistence, transaction management….
- Faster development
  - Testing without an application server (or a database)
  - No deployment to slow you down
- More maintainable
  - Modular object-oriented code
  - Loosely coupled design
- Simpler, perhaps cheaper deployment
  - Deploy in a web-container only server

Drawbacks of POJOs...

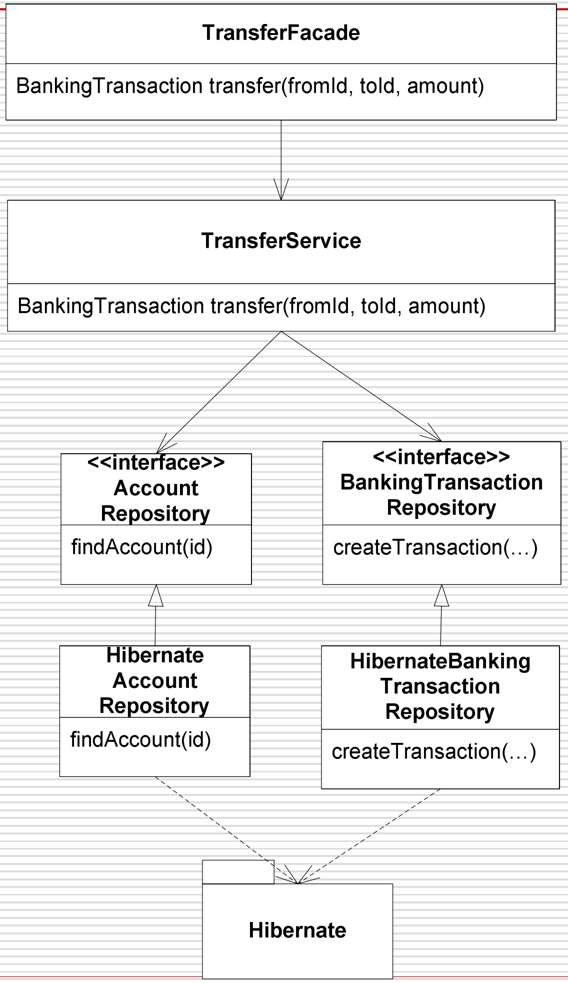
- ...none except that lightweight frameworks have their limitations
- Use EJBs if you need:
  - Distributed transactions initiated by a remote client
  - Some application server-specific features
  - ...

Agenda

- □ The trouble with traditional enterprise Java frameworks
- □ Overview of POJOs
- ➢ **Assembling POJO applications with dependency injection**
- □ Persisting POJOs with Hibernate
- □ Making POJOs transactional with Spring

Dependency injection

- Application components depend on:
  - One another
  - Infrastructure components
- Using JNDI or the new operator:
  - Introduces coupling
  - Complexity
- Solution:
  - Pass dependencies to a component
  - Setter injection
  - Constructor injection


TransferFacade
BankingTransaction transfer(fromId, toId, amount)
TransferService
BankingTransaction transfer(fromId, toId, amount)
<<interface>> Account Repository
findAccount(id)
<<interface>> BankingTransaction Repository
createTransaction(…)
Hibernate Account Repository
findAccount(id)
HibernateBanking Transaction Repository
createTransaction(…)
Hibernate

Dependency injection example

```
public class MoneyTransferServiceImpl
...

public MoneyTransferServiceImpl(
            AccountRepository
                 accountRepository, ...)
{
        this.accountRepository =
                     accountRepository;
        ...
}
```

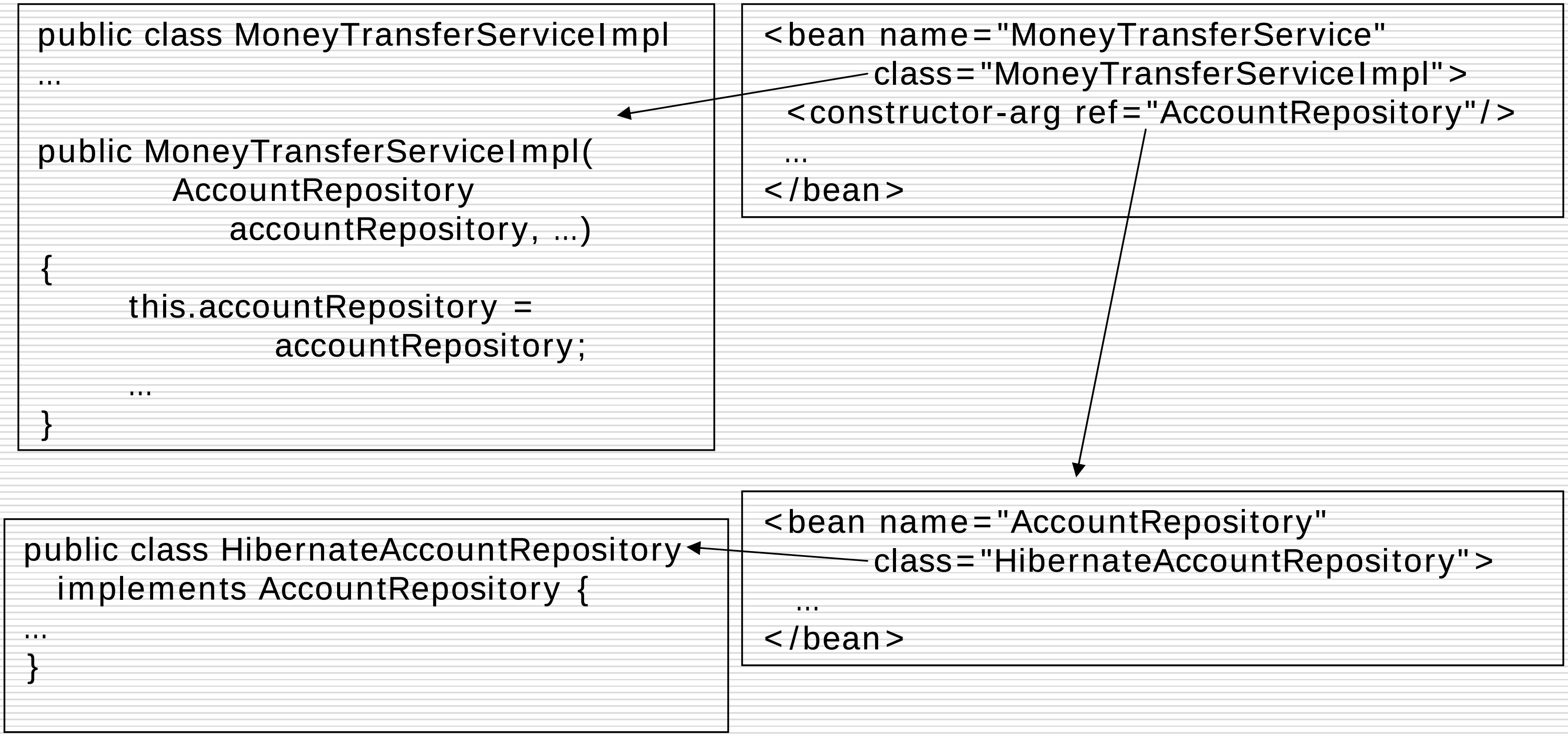
```
public class HibernateAccountRepository
   implements AccountRepository {
...
}
```

- You can implement dependency injection by hand but ....

Spring lightweight container

- Lightweight container = sophisticated factory for creating objects
- Spring bean = object created and managed by Spring
- You write XML that specifies how to:
  - Create objects
  - Initialize them using dependency injection

Spring code example



```
public class MoneyTransferServiceImpl
...

public MoneyTransferServiceImpl(
            AccountRepository
                 accountRepository, ...)
{
        this.accountRepository =
                     accountRepository;
        ...
}
```

```
<bean name="MoneyTransferService"
         class="MoneyTransferServiceImpl">
  <constructor-arg ref="AccountRepository"/>
  ...
</bean>
```

```
<bean name="AccountRepository"
         class="HibernateAccountRepository">
   ...
</bean>
```

```
public class HibernateAccountRepository
   implements AccountRepository {
...
}
```

Spring 2 – dependency injection into entities

- □ Domain model entities need to access repositories/DAOs/etc
- □ But they are created by the application or by Hibernate – not Spring
- □ Passing repositories as method parameters from services clutters the code
- □ Spring 2 provides AspectJ-based dependency injection into entities
- □ Constructors automatically invoke Spring

```
@Configurable("pendingOrder")
public class PendingOrder {

private RestaurantRepository restaurantRepository;

public void
 setRestaurantRepository(RestaurantRepository
                                    restaurantRepository) {
   this.restaurantRepository =
restaurantRepository;
}
```

```
<aop:spring-configured />

<bean id="pendingOrder" lazy-init="true">
  <property name="restaurantRepository"
                ref="RestaurantRepositoryImpl"
   />
</bean>
```

Benefits of dependency injection

- Simplifies code
  - No calls to JNDI
- Decouples components from:
  - One another
  - Infrastructure
- Simplifies testing
  - Pass in a mock/stub during testing

Mock object code example

- Test the MoneyTransferServiceImpl without calling the real AccountRepository

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- □ Making POJOs transactional with Spring

POJO persistence

- □ Use an object/relational framework:
  - ■ Metadata maps the domain model to the database schema
  - ■ ORM framework generates SQL statements
- □ Hibernate
  - ■ Very popular open-source project
- □ JDO
  - ■ Standard from Sun – JSR 12 and JSR 243
  - ■ Multiple implementations: Kodo JDO, JPOX
- □ EJB 3/Java Persistence API (JPA)

Hibernate: code example

- Provides transparent persistence
- Pieces:
  - Account
  - HibernateBankingExample.hbm.xml
  - HibernateAccountPersistenceTests
  - HibernateAccountRepository
  - HibernateAccountRepositoryTests
  - Spring beans
- Only the repositories/DAOs call persistence framework APIs

ORM framework features 1

- Declarative mapping
  - Map classes to tables; fields to columns; relationships to foreign keys and join tables
- CRUD API
  - E.g. Hibernate Session, JPA EntityManager
- Query language
  - Retrieve objects satisfying search criteria
- Transaction management
  - Manual transaction management
  - Rarely call directly – used by Spring
- Detached objects
  - Detach persistent objects from the DB
  - Eliminates use of DTOs
  - Supports edit-style use cases

ORM framework features 2

- Lazy loading
  - Provide the illusion that objects are in memory
  - But loading all objects would be inefficient

  ⇒ load an object when it is first accessed
- Eager loading
  - Loading objects one at a time can be inefficient
  - ⇒ load multiple objects per-select statement
- Caching
  - Database often the performance bottleneck
  - ⇒ cache objects in memory whenever you can
  - Easy for readonly objects
  - Optimistic locking and cache invalidation for changing objects

O/R mapping framework benefits

- Improved productivity
  - High-level object-oriented API
  - Less Java code to write
  - No SQL to write
- Improved performance
  - Sophisticated caching
  - Lazy loading
  - Eager loading
- Improved maintainability
  - A lot less code to write
- Improved portability
  - ORM framework generates database-specific SQL for you

When and when not to use an ORM framework

- Use when the application:
  - Reads a few objects, modifies them, and writes them back
  - Doesn't use stored procedures (much)
- Don't use when:
  - Simple data retrieval ⇒ no need for objects
  - Lots of stored procedures ⇒ nothing to map to
  - Relational-style bulk updates ⇒ let the database do that
  - Some database-specific features ⇒ not supported by ORM framework

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- ➢ **Making POJOs transactional with Spring**

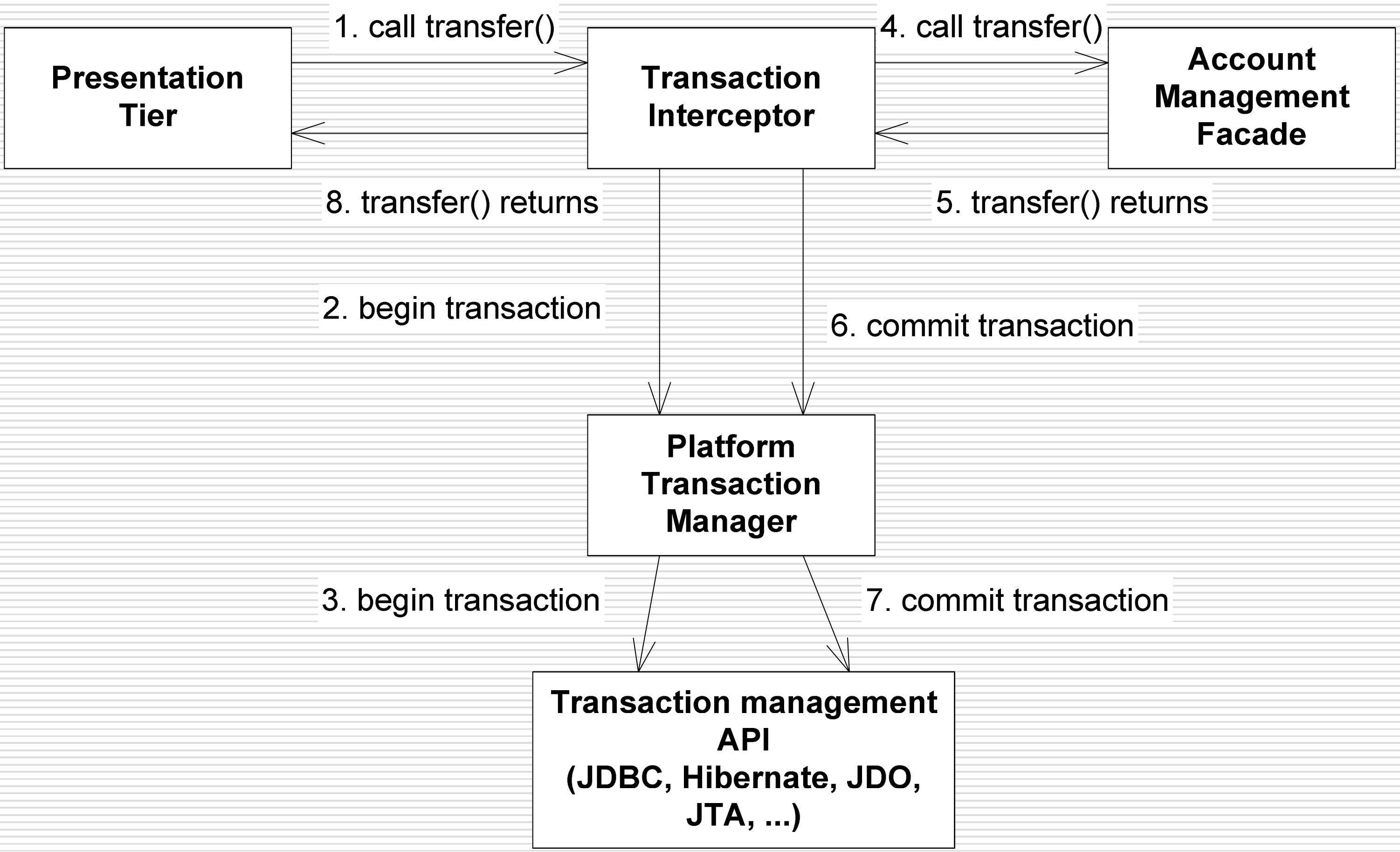
Making POJOs transactional

- □ EJB 2 container-managed transactions are great
- □ Spring provides declarative transactions for POJOs
- □ Similar to CM transactions but
  - ■ Runs outside of an application server
  - ■ More flexible exception handling

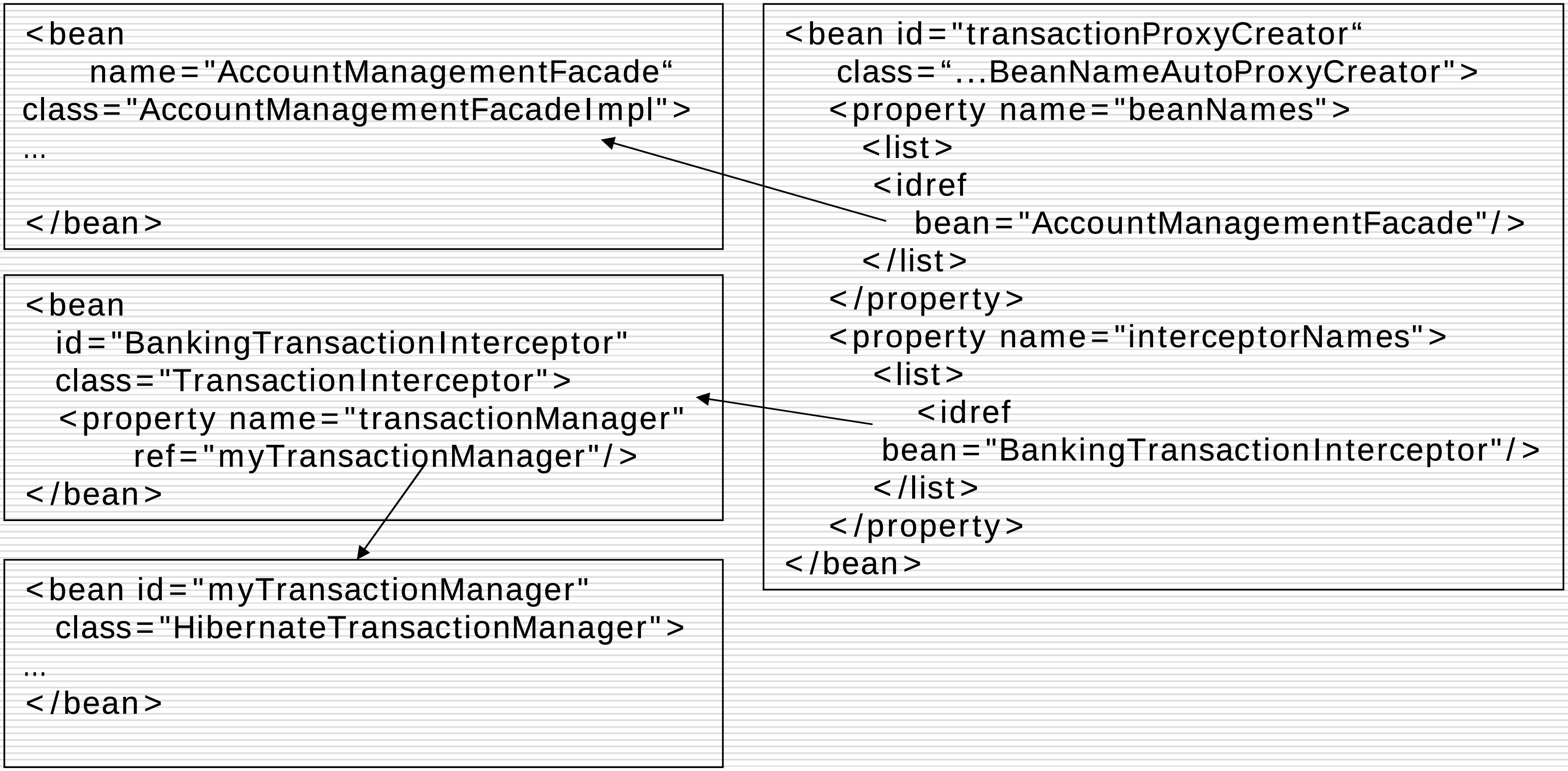
Spring AOP

- AOP enables the modular implementation of crosscutting concerns
- Spring AOP = simple, effective AOP implementation
- Lightweight container can wrap objects with proxies
- Proxy executes extra code:
  - Before original method
  - After original method
  - Instead of…
- Spring uses proxies for:
  - transaction management
  - security
  - tracing
  - …

Spring TransactionInterceptor



Spring code example



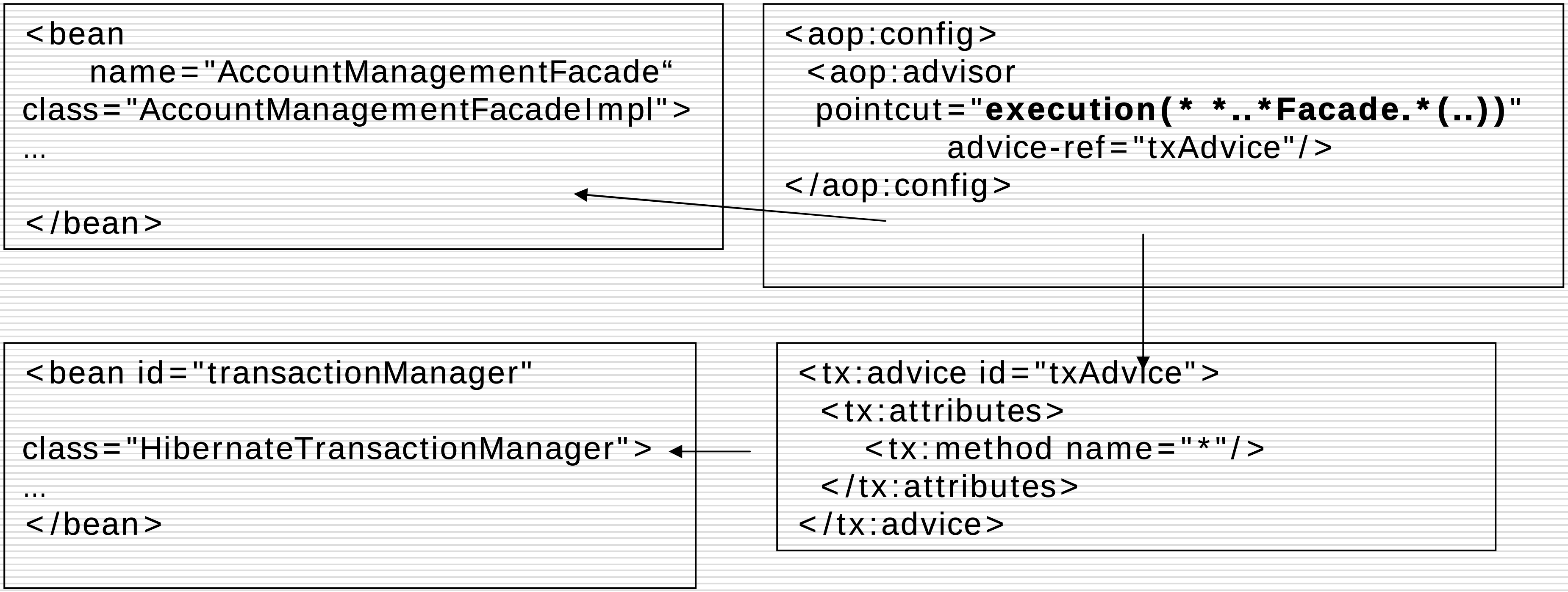
```
<bean
     name="AccountManagementFacade“
class="AccountManagementFacadeImpl">
...

</bean>
```

```
<bean
  id="BankingTransactionInterceptor"
  class="TransactionInterceptor">
   <property name="transactionManager"
         ref="myTransactionManager"/>
</bean>
```

```
<bean id="myTransactionManager"
  class="HibernateTransactionManager">
...
</bean>
```

```
<bean id="transactionProxyCreator“
    class=“...BeanNameAutoProxyCreator">
    <property name="beanNames">
      <list>
       <idref
          bean="AccountManagementFacade"/>
      </list>
    </property>
    <property name="interceptorNames">
       <list>
           <idref
        bean="BankingTransactionInterceptor"/>
       </list>
    </property>
</bean>
```

Spring 2 – simplified XML



```
<bean
     name="AccountManagementFacade“
class="AccountManagementFacadeImpl">
...

</bean>
```

```
<aop:config>
  <aop:advisor
   pointcut="execution(* *..*Facade.*(..))"
               advice-ref="txAdvice"/>
</aop:config>
```

```
<bean id="transactionManager"

class="HibernateTransactionManager">
...
</bean>
```

```
<tx:advice id="txAdvice">
  <tx:attributes>
     <tx:method name="*"/>
  </tx:attributes>
</tx:advice>
```

Spring remoting

- □ Remoting
  - Spring HTTP
  - Hessian/Burlap
  - RMI
  - …
- □ Server uses a <Xyz>Exporter bean
  - Service to expose
  - Interface to expose
- □ Client uses a <Xyz>ProxyFactoryBean
  - URL to remote service

```
<bean name="/accountManagement"
      class="org.springframework.remoting.httpi
      nvoker.
       HttpInvokerServiceExporter">

  <property name="service"
      ref="TransferFacade"/>
  <property name="serviceInterface"
    value="net.chrisrichardson…TransferFacade"
  />
</bean>

<bean id="httpInvokerProxy"
      class="org.springframework.remoting.httpi
      nvoker.
    HttpInvokerProxyFactoryBean">
  <property name="serviceUrl"
      value="http://somehost:8080/accountManage
      ment"/>
 <property name="serviceInterface"
    value="net.chrisrichardson…TransferFacade"
  />
</bean>
```

Spring Security

- Acegi Security
  - Open source project
  - Extension to Spring
- MethodSecurityInterceptor
- Verifies that caller is authorized
  - Invoke method
  - Access instances

```
  <bean id=“transferSecurity"
      class="org.acegisecurity.inter
      cept.method.aopalliance.
         MethodSecurityInterceptor">
…
   <property
      name="objectDefinitionSource">
    <value>
  net.chrisrichardson…
     TransferFacade.*=
        ROLE_CUSTOMER, ROLE_CSR
     </value>
   </property>

</bean>
```

Deploying a Spring application

- Often packaged as a WAR
- Web.xml lists bean definition files
- ServletContextListener creates Spring bean factory
- Web tier is either:
  - Injected with Spring beans
  - Calls getBean()

```
<web-app>

<context-param>
  <param-name>contextConfigLocation
    </param-name>
  <param-value>
 /beans1.xml
 /beans2.xml
  </param-value>
</context-param>

<listener>
 <listener-class>
     org.springframework.web.context.C
     ontextLoaderListener
 </listener-class>
</listener>

..
```

Summary

POJOs

+

Non-invasive frameworks

=

- □ Simplify development
- □ Accelerate development
- □ Improve maintainability
- □ Increase immunity to rapidly evolving infrastructure frameworks

For more information

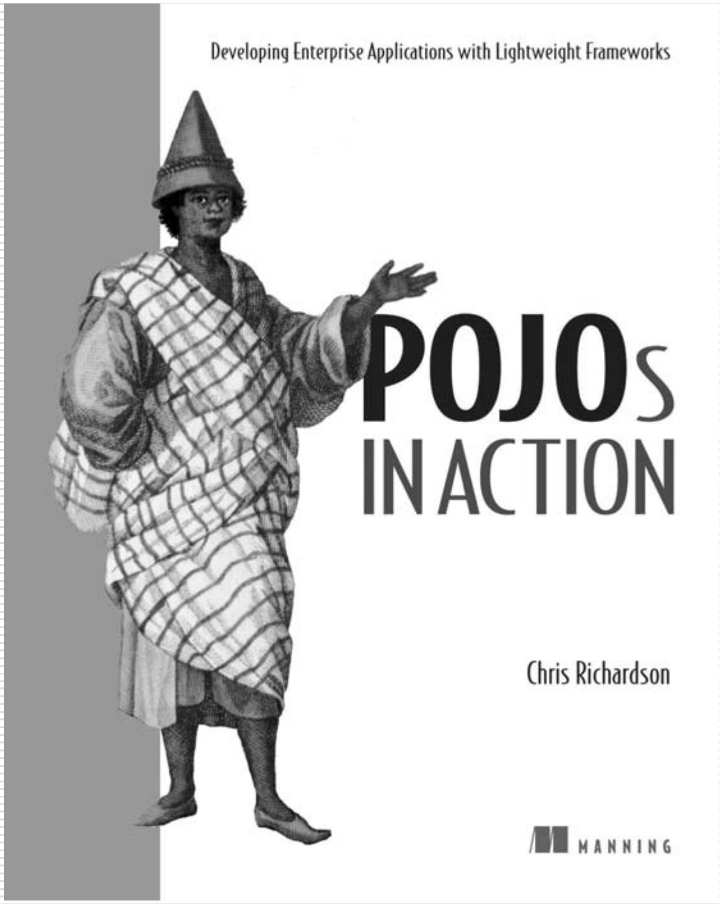
- □ Buy my book ☺
- □ Send email:

chris@chrisrichardson.net

- □ Visit my website:

http://www.chrisrichardson.net

- □ **Please hand in your session evaluations**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Extra slides

Thoughts about EJB 3 and POJOs

- ☺ Better than EJB2
- ☺ Supports POJOs
- ☺ Reasonable ORM
- ☺ Entity beans = JPA
- ☺ Annotations are concise
- ☺ Has dependency injection
- ☺ It’s a standard

- ☹ Less powerful than Spring, e.g. DI relies on JNDI
- ☹ Less powerful than Hibernate, e.g. List<String>
- ☹ Session beans/MDBs must be deployed
- ☹ Complexity of EJB lurking within
- 💣 Annotations couple your code to EJB3
- ☠ EJB’s poor track record as a standard

Using Spring with EJBs

- Simplify EJB client code with Spring
  - Spring encapsulates JNDI lookup
  - Client gets EJB reference from Spring
  - Better: Client is injected with EJB reference
- Move business logic into Spring beans
  - Session EJBs delegate to Spring beans
  - Use Spring dependency injection
  - Simpler code, easier testing
- Simplify DAOs with Spring JDBC
  - Eliminates error-prone boilerplate code

Migrating to POJOs – part 1

- 2 year old application:
  - Session EJBs
  - Entity Bean-based domain model
  - Some JDBC DAOs
  - Beginning development of version 2
- Replaced entity beans with Hibernate:
  - WAS vs. WLS portability
  - Test business logic without persistence
  - Test persistence without a server
  - A much richer domain model

Migrating to POJOs – part 2

- Used Spring beans for V2 code
- Incrementally replaced V1 session beans with Spring beans when:
  - Enhancing it
  - V2 code needed to call V1 code
- End result:
  - Richer domain model
  - Faster development
  - V2 code was deployable as a web app.