ENTERPRISE DEVELOPMENT SERVICES DIRECT FROM THE CREATORS OF SPRING FRAMEWORK

INTERFACE21

AOP in the Enterprise

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Spring

Agenda

- Where does AOP fit?
- Matching requirements to implementation
- AOP in Spring 2.5

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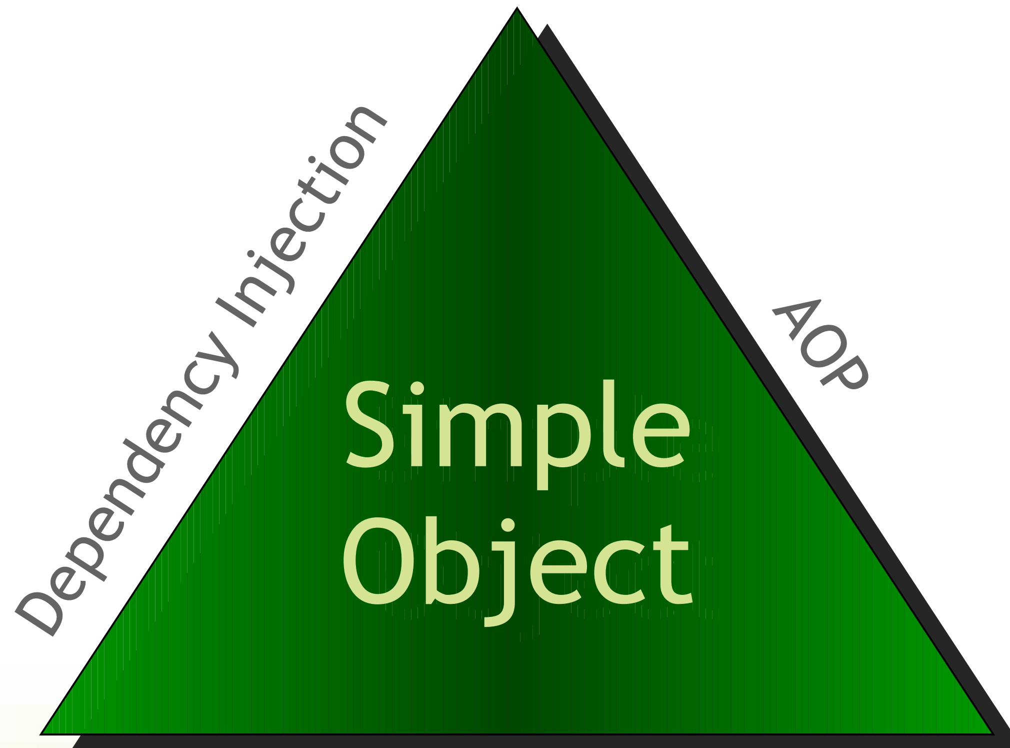

Portable Service Abstractions

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the vocabulary of enterprise applications

business service

service layer

repository

dao

controller

web layer

data access layer

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Requirements

- the service layer should be transactional
- when a Hibernate dao operation fails the exception should be translated
- a business service that fails with a concurrency related failure can be retried
- service layer objects should not call the web layer

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It would be simpler…

and more *powerful*

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if we could use these

~~terms~~ abstractions

directly in the

implementation

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terms -> abstractions

```
@Aspect
public class SystemArchitecture {

  @Pointcut("within(a.b.c.service..*")
  public void inServiceLayer() {}

  @Pointcut("within(a.b.c.dao..*")
  public void inDataAccessLayer() {}

  @Pointcut("execution(* a.b.c.service.*.*(..))")
  public void businessService() {}


  …
}
```

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Requirements

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Transactional service layer…

```
<aop:config>
  <aop:advisor
     pointcut="SystemArchitecture.businessService()"
     advice-ref="tx-demarcation"/>
</aop:config>
```

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Transaction metadata

```
<tx:advice id="tx-demarcation">
  <method name="*"
    propagation="REQUIRED"
    isolation="DEFAULT"/>
</tx:advice>
```

- Gives us TX-REQUIRED semantics for the service layer

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Transactional annotation

```
/**
 * default to required, read-write for all
 *  operations
 */
@Transactional
public class AccountService {
  /** this one is read-only… */
  @Transactional(readOnly=true)
  public Account getAccount(AccountNum accNo) {
   …
  }
  …
}
```

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Transactional annotation

- Now the configuration just becomes…

```
<!– tell Spring to perform transaction demarcation on
   bean operations based on @Transactional annotations
   -->
<tx:annotation-driven/>
```

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Requirements

- ✔ the service layer should be transactional
- ➔ **when a Hibernate dao operation fails the exception should be translated**
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Scenario…

- You have your own data access layer written using Hibernate 3
  - not using the Spring HibernateTemplate
- In the service layer, you want to insulate yourself from Hibernate exceptions, and take advantage of Spring's fine-grained DataAccessException hierarchy
- After throwing a hibernate exception from a data access operation, convert it into a DataAccessException…

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Step 1: Define the abstraction

```
@Aspect
public class SystemArchitecture {

  …

  @Pointcut("execution(* a.b.c.dao.*.*(..))")
  public void dataAccessOperation() {}

  …
}
```

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"After throwing a hibernate exception from a data access operation, convert it into a DataAccessException…"

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Step 2: use the abstraction

```
@AfterThrowing(
  throwing="hibernateEx",
  pointcut="SystemArchitecture.dataAccessOperation()" )
public void rethrowAsDataAccessException(
  HibernateException hibernateEx) {
  // convert exception and rethrow…
}
```

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Where does advice live?

- Advice is declared in an aspect
- Aspects are like classes
  - instances
  - state (fields)
  - behaviour (methods)
- Aspects can also have
  - pointcuts
  - advice
  - and a few other things…

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Aspect

```
@Aspect
public class HibernateExceptionTranslator {
     // …

    @AfterThrowing(
      throwing="hibernateEx",
      pointcut="SystemArchitecture.dataAccessOperation()"
    )
    public void rethrowAsDataAccessException(
      HibernateException hibernateEx) {
      // convert exception and rethrow…
    }
}
```

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Step 3: Configuration

```
<aop:aspectj-autoproxy/>

<context:component-scan>
  <context:include-filter type="annotation"
      expression="org.aspectj.lang.annotation.Aspect"/>
</context:component-scan>
```

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Schema alternative

- For JDK 1.4 and below
- The exact same aspect can be declared in Spring XML, backed by a plain Java class

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Schema-based configuration

```
<aop:config>

  <aop:aspect ref="hibernateExceptionTranslator">
    <aop:after-throwing
        throwing="hibernateEx"
        pointcut="SystemArchitecture.dataAccessOperation()"
        method="rethrowAsDataAccessException"/>
  </aop:aspect>

</aop:config>
```

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Bean Implementation

```
public class HibernateExceptionTranslator {
  private HibernateTemplate hibernateTemplate;

  public void setHibernateTemplate(
    HibernateTemplate aTemplate){
    this.hibernateTemplate = aTemplate;
  }

  public void rethrowAsDataAccessException(
       HibernateException hibernateEx) {
    throw this.hibernateTemplate
        .convertHibernateAccessException(hibernateEx);
  }
}
```

parameter bound
in pcut expression

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@Repository

- This exception translation is available "out of the box" in Spring 2.0 and above
- Simply annotate repository / dao objects with @Repository
- Define the exception translation bean in your configuration
  - PersistenceExceptionTranslationPostProcessor

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Requirements

- the service layer should be transactional
- when a Hibernate dao operation fails the exception should be translated
- **a business service that fails with a deadlock loser failure can be retried**
- service layer objects should not call the web layer

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Retry

- One subtype of DataAccessException is…
  - DeadlockLoserDataAccessException
- Deadlock failures are potentially recoverable
  - If the operation is idempotent, we can retry it*
- We need a DeadlockLoserRetry aspect…

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Deadlock Loser Recovery

```
@Aspect
public class DeadlockLoserRetry {
  private static final int DEFAULT_MAX_ATTEMPTS = 3;
  private int maxAttempts = DEFAULT_MAX_ATTEMPTS;

  /** configurable via dependency injection */
  public void setMaxAttempts(int newMax) {
    this.maxAttempts = newMax;
  }


 …
```

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Deadlock Loser Recovery

```
@Around("idempotentOperation()")
public Object retryDeadlockLosers(ProceedingJoinPoint pjp)
throws Throwable {
  int attempts = 0;
  DeadlockLoserDataAccessException loserEx = null;
  while (attempts++ < maxAttempts) {
    try {
      return pjp.proceed();
    }
    catch (DeadlockLoserDataAccessException ex) {
      loserEx = ex;
    }
  }
  throw loserEx;
}
```

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Schema-based equivalent

```
<aop:config>

  <aop:aspect ref="deadlockLoserRetry">
    <aop:pointcut id="idempotentOperation"
        expression= "SystemArchitecture.businessService()"/>

    <aop:around
        pointcut-ref="idempotentOperation"
        method="doConcurrentOperation"/>
  </aop:aspect>

</aop:config>
```

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Schema-based Equivalent

```
<bean id="deadlockLoserRetry"
   class="DeadlockLoserRetry">
   <property name="maxAttempts" value="2"/>
</bean>
```

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Recap:

- Created an abstraction: idempotentOperation
- Used around advice to retry failing idempotentOperations
- Packaged in a ConcurrentOperationExecutor aspect
- Configured using Spring

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Idempotent operations

- It would be nice if all of our service layer operations were idempotent
- But what if some of them aren't?
- We'd need a way to identify and retry only the idempotent subset…

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Idempotent operations

```
@Retention(RetentionPolicy.RUNTIME)
public @interface Idempotent {}
```

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Idempotent operations

- Just update the abstraction (pointcut expression)…

```
<aop:pointcut id="idempotentOperation"
    expression=
        "SystemArchitecture.businessService()
         and @annotation(Idempotent)"/>
```

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Permitted component interactions

```
/** … */
public aspect SystemArchitecture {
 …
 /*
  * no other module should depend on the
  * web tier
  */
 declare warning
   : callToWebTier() && !inWebTier()
   : "no external dependencies on web tier";

  …
}
```

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Demo

- Hibernate usage guidelines…

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AOP in Spring 2.5

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Spring 2.5 AOP

- Aspects are defined in Spring configuration file
  - supports both XML based definition
  - and @AspectJ aspects
- XML defined aspects are backed by regular classes

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Spring 2.5 and AspectJ

- Spring and AspectJ are still distinct projects
- Spring just uses the AspectJ pointcut parsing and matching APIs
  - using AspectJ as a library, not as a weaving engine
- Gives the same syntax and semantics across Spring AOP and AspectJ
  - perfect if you are going to use both
  - or start out with Spring AOP, and then want to introduce AspectJ at some point

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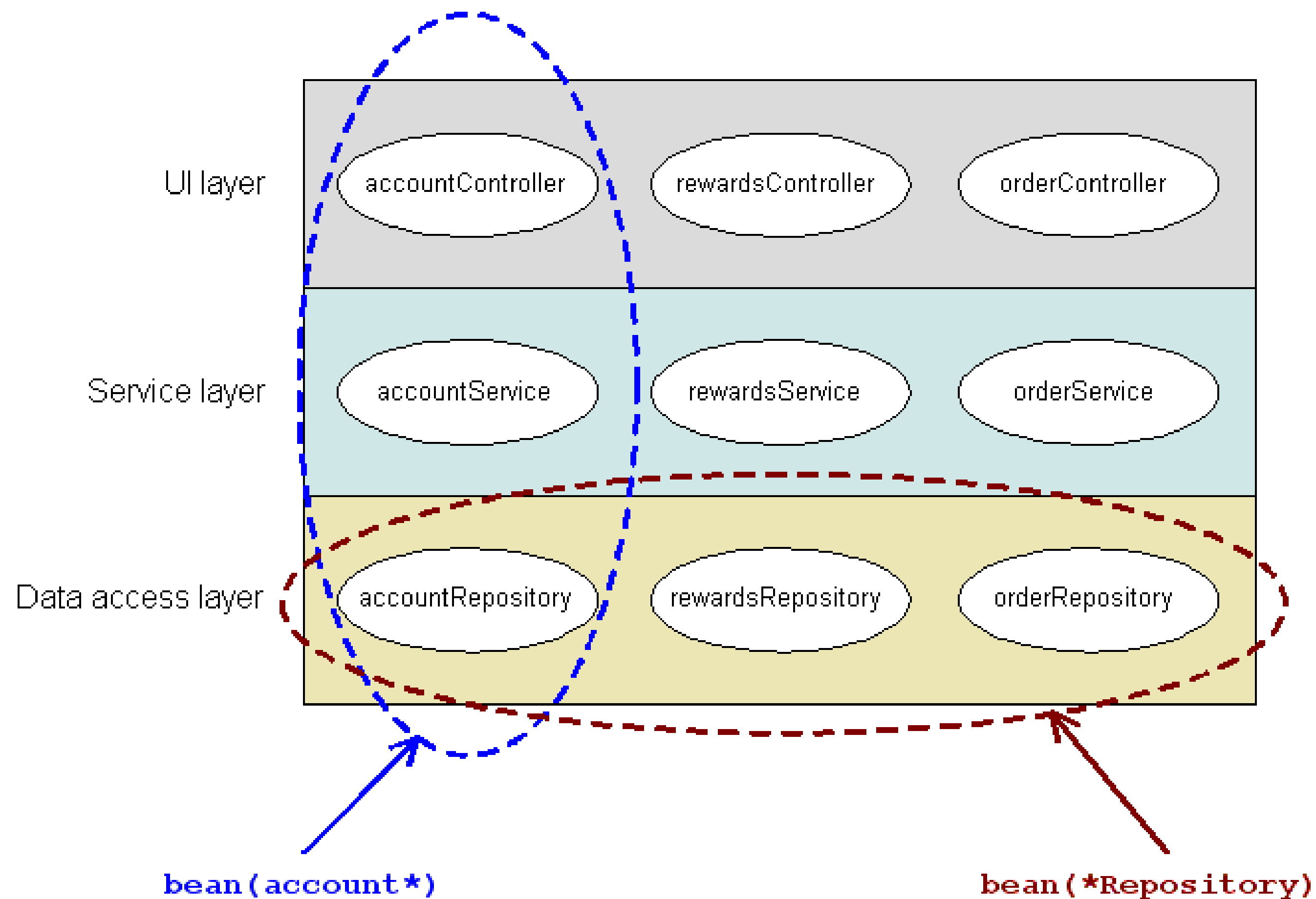
New in Spring 2.5

- bean()



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New in Spring 2.5

- <context:load-time-weaver/>
  - aspectj-weaving="on | off | autodetect"

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Summary

- We want to implement enterprise requirements in as simple and straightforward a manner as possible
  - use the appropriate implementation "vocabulary"
- AOP provides the necessary abstractions
- AspectJ and Spring AOP are the leading AOP implementations
  - tightly integrated
  - Can use together or independently

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Questions?