7 Reasons to use Spring

Arjen Poutsma
SpringSource

About Me

- Fifteen years of experience in Enterprise Software Development
- Development lead of Spring Web Services
- Developer on Spring 3
- Contributor to various Open Source frameworks: (XFire, Axis2, NEO, ...)

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About Spring

Aims of Spring

- Reduce the complexity of Java J2EE development
  - Simplify without sacrificing power
  - Facilitate best practices
  - Grew from practical experience

Simple things should be simple. Complex things should be possible.

Alan Kay

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Technical Aims of Spring

- Write POJOs
- Apply Java EE services to POJOs
- Make it transactional
- Expose via JMX
- ...

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POJO development

- Plain Old Java Object
- Not bound to any environment
  - No environment-specific imports
  - Not dependent on lookup mechanism
    - Dependencies are injected
  - Prolongs life
- **Test out of the container**

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Modular

- Spring is not a "package deal"
- All features can be used independently
  - Though they strengthen each other

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Reason #1

Dependency Injection

The Case for Dependency Injection

- Applications consist of multiple components
- How obtain these dependencies?

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Pull Configuration

- JNDI lookup
- Properties file
- Service Locator anti-pattern
- Many issues
  - Most importantly: hard to test

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Solution: Dependency Injection

- Rather than lookup dependencies
- Let something give them to me
  - Spring

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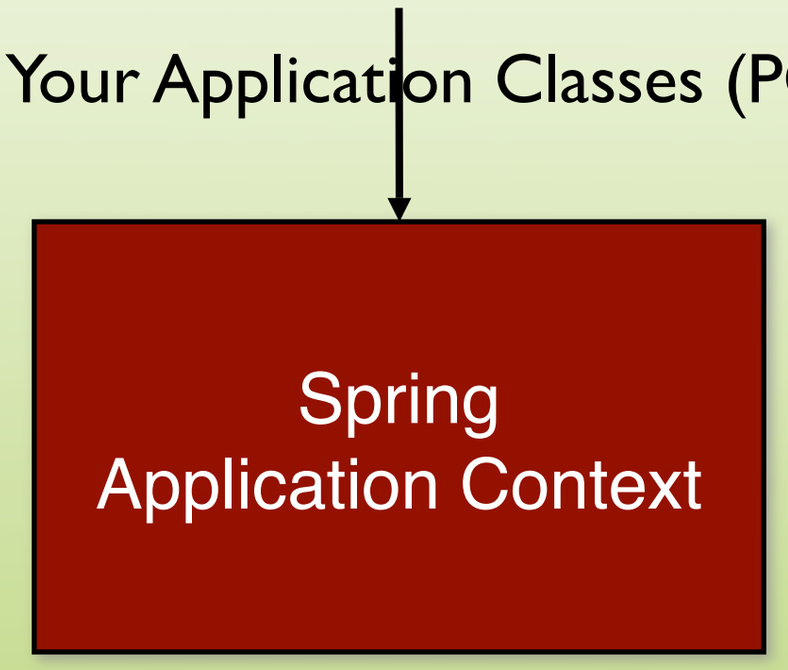
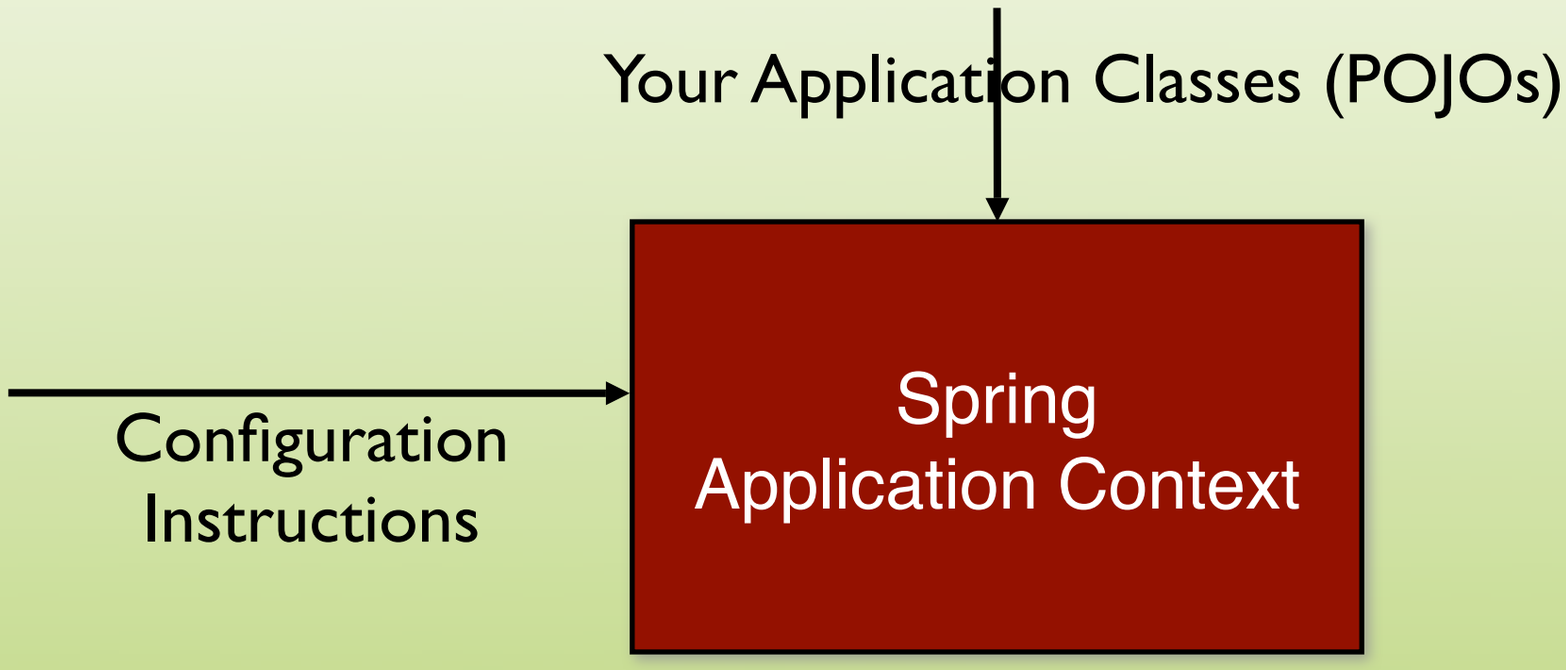
How Spring Works

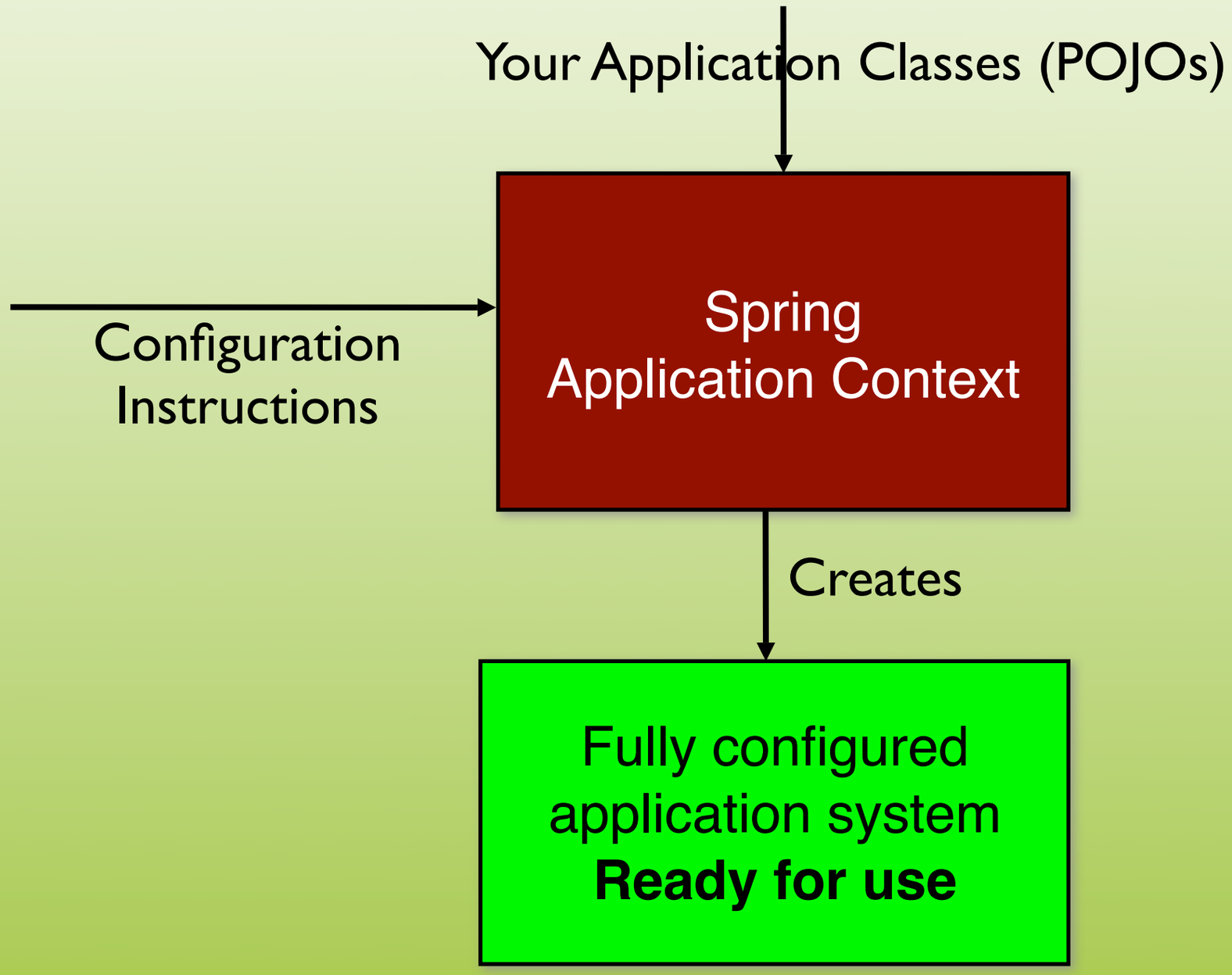
How Spring Works



How Spring Works



How Spring Works



Example

Example

```
public class TransferServiceImpl implements TransferService {
    public TransferServiceImpl(AccountRepository ar) {
        this.accountRepository = ar;
    }
    …
}
```

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Needed to perform money transfers between accounts

Example

```
public class TransferServiceImpl implements TransferService {
    public TransferServiceImpl(AccountRepository ar) {
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    }
    …
}
```

Needed to perform money transfers between accounts

```
public class JdbcAccountRepository implements AccountRepository {
    public JdbcAccountRepository(DataSource ds) {
        this.dataSource = ds;
    }
    …
}
```

Example

```
public class TransferServiceImpl implements TransferService {
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Needed to perform money transfers between accounts

```
public class JdbcAccountRepository implements AccountRepository {
    public JdbcAccountRepository(DataSource ds) {
        this.dataSource = ds;
    }
    …
}
```

Needed to load accounts from the database

Example

Example

```
<beans>

   <bean id="transferService" class="app.impl.TransferServiceImpl">
      <constructor-arg ref="accountRepository" />
   </bean>

   <bean id="accountRepository" class="app.impl.JdbcAccountRepository">
      <constructor-arg ref="dataSource" />
   </bean>

   <bean id="dataSource" class="com.oracle.jdbc.pool.OracleDataSource">
      <property name="URL" value="jdbc:oracle:thin:@localhost:1521:BANK" />
      <property name="user" value="moneytransfer-app" />
   </bean>

</beans>
```

“Spring Sucks!”

- Spring is XML
- XML is Evil
- Being Evil sucks

- Therefore, Spring sucks

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Spring != XML

- @Component
- @Autowired
- JSR-250
  - @Resource
  - @PostContruct/@PreDestroy

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@Component
@Autowired

```
@Component
public class TransferServiceImpl implements TransferService
    @Autowired
    public TransferServiceImpl(AccountRepository ar) {
        this.accountRepository = ar;
    }
    ...
}
```

Why not use Java EE Dependency Injection?

- Testing, inside IDE
- Java EE only allows injection of JNDI-managed objects
- Spring injects everything
  - Primitives (configuration)

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Reason #2

JdbcTemplate

JDBC

- Object/Relational Mapping is popular
- But JDBC continues to be important
  - Batch Operations
  - Set-based operations
  - Stored procedures

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Redundant, Error Prone Code

```
public List findByLastName(String lastName) {
   List personList = new ArrayList();
   Connection conn = null;
   String sql = “select first_name, age from PERSON where last_name=?“;
   try {
      DataSource dataSource = DataSourceUtils.getDataSource();
      conn = dataSource.getConnection();
      PreparedStatement ps = conn.prepareStatement(sql);
      ps.setString(1, lastName);
      ResultSet rs = ps.executeQuery();
      while (rs.next()) {
         String firstName = rs.getString(”first_name“);
         int age = rs.getInt(“age”);
         personList.add(new Person(firstName, lastName, age));
      }
   } catch (Exception e) { /* ??? */ }
   finally {
      try {
         conn.close();
      } catch (SQLException e) { /* ??? */ }
   }
   return personList;
}
```

Redundant, Error Prone Code

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  String sql = "select first_name, age from PERSON where last_name=?";
  try {
    DataSource dataSource = DataSourceUtils.getDataSource();
    conn = dataSource.getConnection();
    PreparedStatement ps = conn.prepareStatement(sql);
    ps.setString(1, lastName);
    ResultSet rs = ps.executeQuery();
    while (rs.next()) {
      String firstName = rs.getString("first_name");
      int age = rs.getInt("age");
      personList.add(new Person(firstName, lastName, age));
    }
  } catch (Exception e) { /* ??? */ }
  finally {
    try {
      conn.close();
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Redundant, Error Prone Code

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      personList.add(new Person(firstName, lastName, age));
    }
  } catch (Exception e) { /* ??? */ }
  finally {
    try {
      conn.close();
    } catch (SQLException e) { /* ??? */ }
  }
  return personList;
}
```

The bold matters - the rest is boilerplate

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JdbcTemplate

```
int count = jdbcTemplate.queryForInt(
"SELECT COUNT(*) FROM CUSTOMER");
```


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JdbcTemplate

```
int count = jdbcTemplate.queryForInt(
    "SELECT COUNT(*) FROM CUSTOMER");
```

- Acquisition of the connection
- Participation in the transaction
- Execution of the statement
- Processing of the result set
- Handling any exceptions
- Release of the connection

All handled by Spring

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Querying With SimpleJdbcTemplate

```
public int getCountOfPersonsOlderThan(int age) {
    return jdbcTemplate().queryForInt(
  “select count(*) from PERSON where age > ?”, age);
}
```

Domain Objects

```
public Person getPerson(int id) {
    return getSimpleJdbcTemplate().queryForObject(
        “select first_name, last_name from PERSON where id=?”,
        new PersonMapper(), id);
}
```

Domain Objects

```
public Person getPerson(int id) {
    return getSimpleJdbcTemplate().queryForObject(
        “select first_name, last_name from PERSON where id=?”,
        new PersonMapper(), id);
}
```

```
class PersonMapper implements ParameterizedRowMapper<Person> {
    public Person mapRow(ResultSet rs, int i) {
        return new Person(rs.getString(1), rs.getString(2));
    }
}
```

Reason #3

Exception Hierarchy

Poor Exception Handling

```
public List findByLastName(String lastName) {
   List personList = new ArrayList();
   Connection conn = null;
   String sql = "select first_name, age from PERSON where last_name=?“;
   try {
      DataSource dataSource = DataSourceUtils.getDataSource();
      conn = dataSource.getConnection();
      PreparedStatement ps = conn.prepareStatement(sql);
      ps.setString(1, lastName);
      ResultSet rs = ps.executeQuery();
      while (rs.next()) {
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      }
   } catch (Exception e) { /* ??? */ }
   finally {
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```

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Poor Exception Handling

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   } catch (Exception e) { /* ??? */ }
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      try {
         conn.close();
      } catch (SQLException e) { /* ??? */ }
   }
   return personList;
}
```

What can you do?

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What can you do?

- Nothing
- Logging
- Wrapping
- Retry

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Dead Lock Loser

```
} catch (SQLException ex) {
        if (ex.getErrorCode() == 60) {// check for ORA-00060
                return findByLastName(lastName);
        } else {
                throw ex;
        }
}
```

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Retry

- Ugly code
- Not portable
  - JDBC vs JPA
  - Oracle vs SQL Server

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In Spring

- Spring does exception translation
- Into a rich Exception Hierarchy
  - Catch DeadLockLoserException
  - Use AOP!

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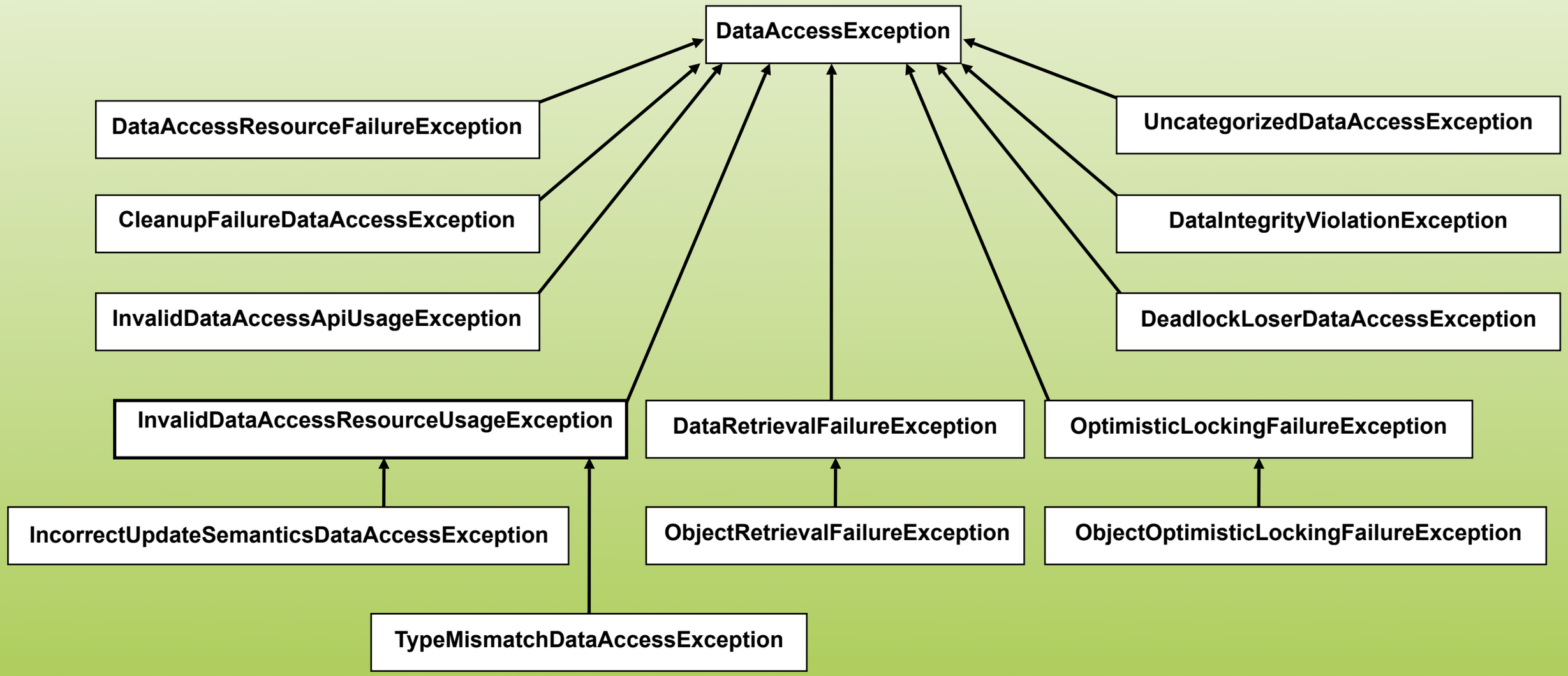
DataAccessException Hierarchy (subset)



Reason #4

Aspect-Oriented Programming

What Problem Does AOP Solve?

Aspect-Oriented Programming (AOP) enables modularization of cross-cutting concerns

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What are Cross-Cutting Concerns?

Generic functionality that is needed in many places in your application

- Logging and Tracing
- Transaction Management
- Security
- Caching
- Error Handling
- Performance Monitoring
- Custom Business Rules

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An Example Requirement

- Perform a role-based security check before every application method

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An Example Requirement

- Perform a role-based security check before every application method

A sign this requirement is a cross-cutting concern

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Without AOP

- Failing to modularize cross-cutting concerns leads to two things
  - Code tangling
    - A coupling of concerns
  - Code scattering
    - The same concern spread across modules

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Tangling

```
public class RewardNetworkImpl implements RewardNetwork {
    public RewardConfirmation rewardAccountFor(Dining dining) {
        if (!hasPermission(SecurityContext.getPrincipal()) {
            throw new AccessDeniedException();
        }
        Account a = accountRepository.findByCreditCard(…
        Restaurant r = restaurantRepository.findByMerchantNumber(…
        MonetaryAmount amt = r.calculateBenefitFor(account, dining);
        …
    }
}
```

Tangling

```
public class RewardNetworkImpl implements RewardNetwork {
    public RewardConfirmation rewardAccountFor(Dining dining) {
        if (!hasPermission(SecurityContext.getPrincipal()) {
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        Account a = accountRepository.findByCreditCard(…
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        MonetaryAmount amt = r.calculateBenefitFor(account, dining);
        …
    }
}
```

Mixing of concerns

Scattering

```
public class HibernateAccountManager implements AccountManager {
    public Account getAccountForEditing(Long id) {
        if (!hasPermission(SecurityContext.getPrincipal()) {
            throw new AccessDeniedException();
        }
        …
```

```
public class HibernateMerchantReportingService implements
MerchantReportingService {
    public List<DiningSummary> findDinings(String merchantNumber,
                                           DateInterval interval) {
        if (!hasPermission(SecurityContext.getPrincipal()) {
            throw new AccessDeniedException();
        }
        …
```

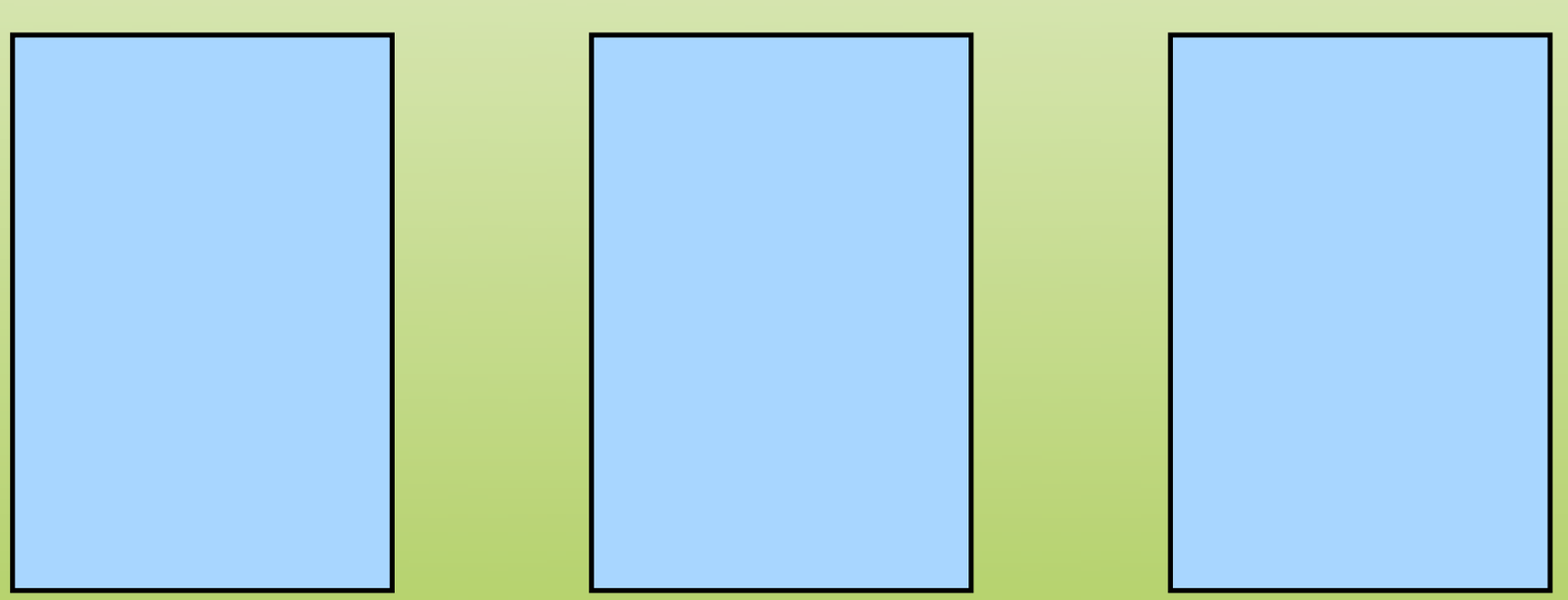
Scattering

```
public class HibernateAccountManager implements AccountManager {
    public Account getAccountForEditing(Long id) {
        if (!hasPermission(SecurityContext.getPrincipal()) {
            throw new AccessDeniedException();
        }
        …
```

Duplication

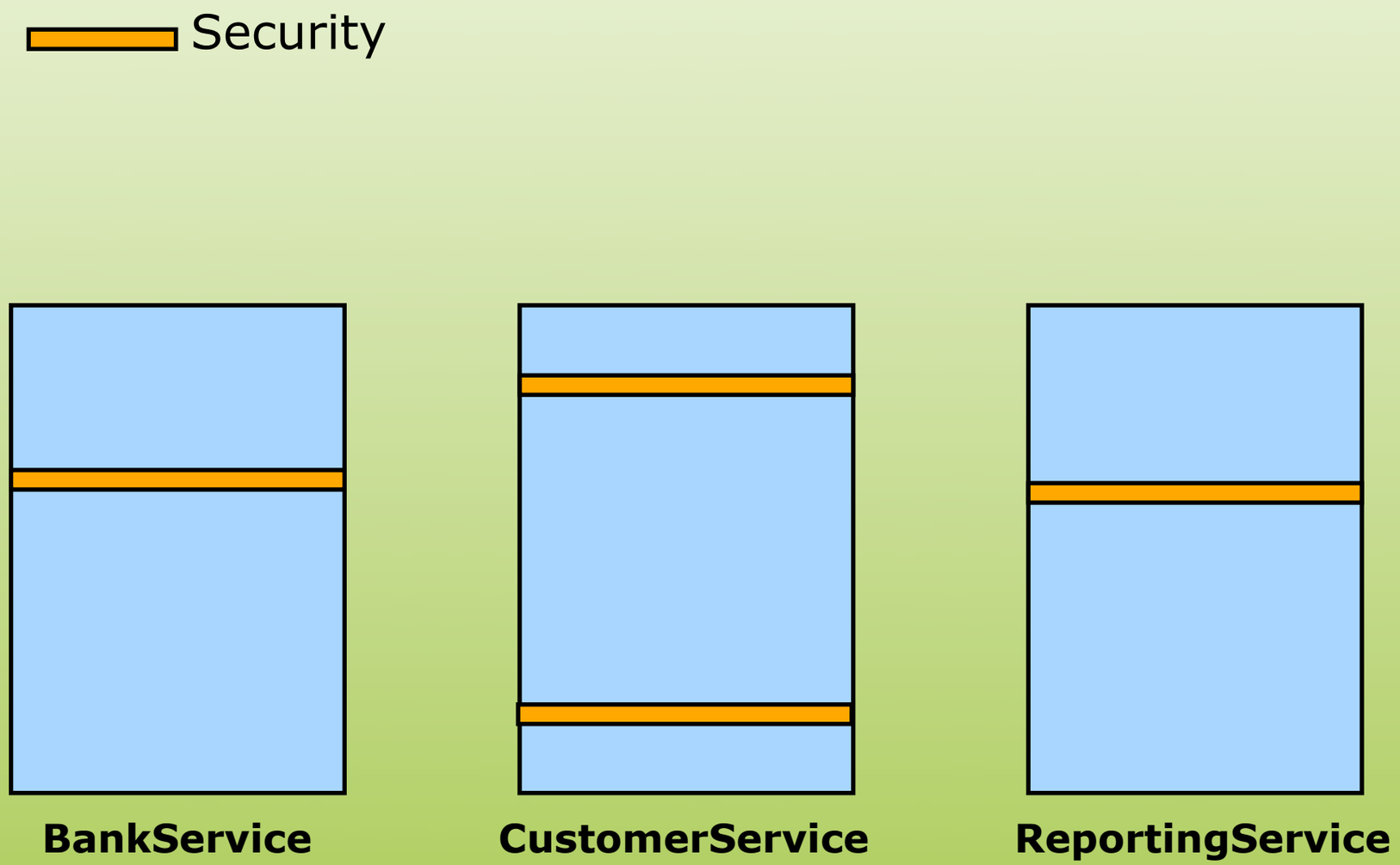
```
public class HibernateMerchantReportingService implements
MerchantReportingService {
    public List<DiningSummary> findDinings(String merchantNumber,
                                           DateInterval interval) {
        if (!hasPermission(SecurityContext.getPrincipal()) {
            throw new AccessDeniedException();
        }
        …
```

Without AOP



BankService **CustomerService** **ReportingService**

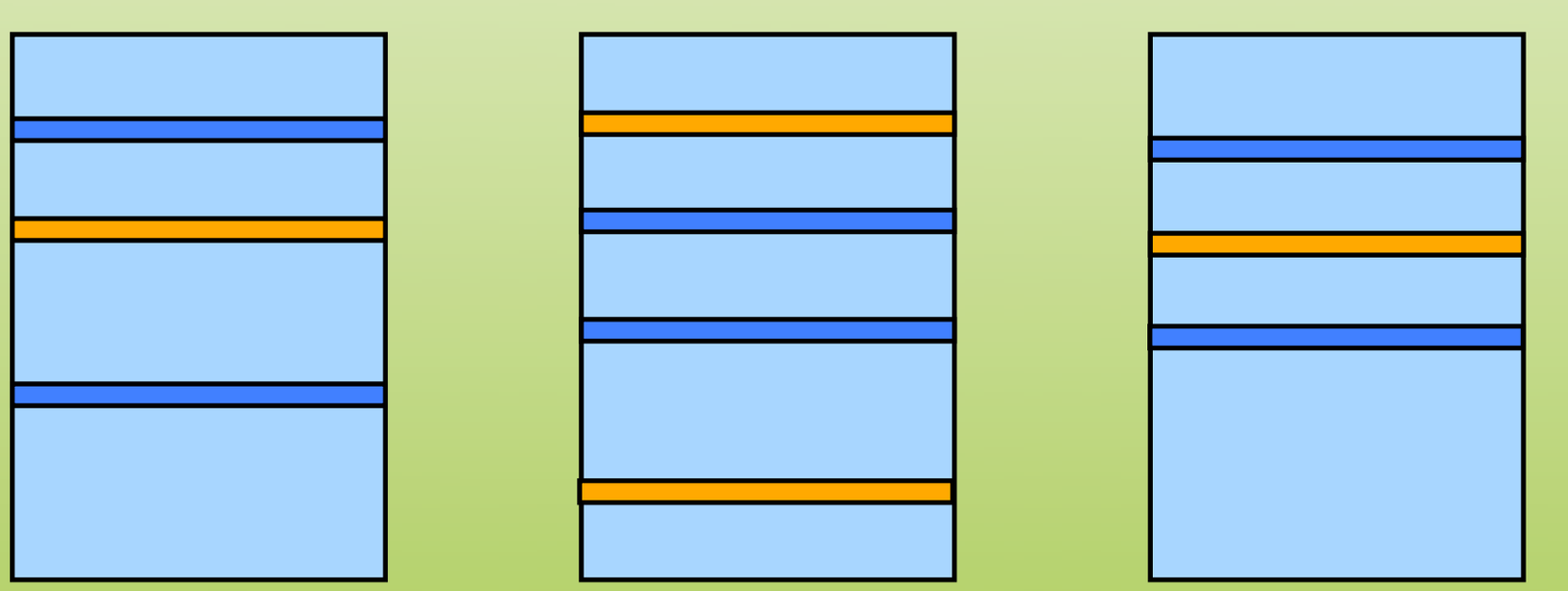
Without AOP


Security
BankService
CustomerService
ReportingService

Without AOP

Security

Transactions



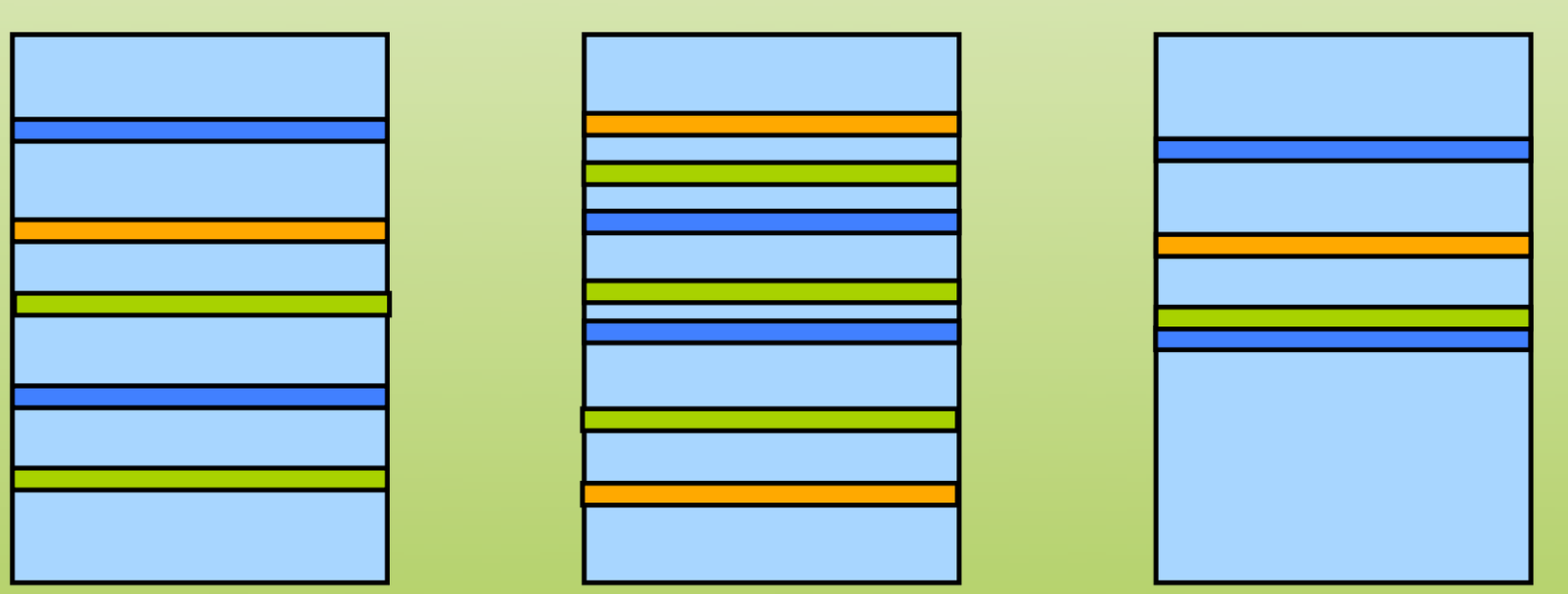
BankService **CustomerService** **ReportingService**

Without AOP

Security

Transactions

Logging



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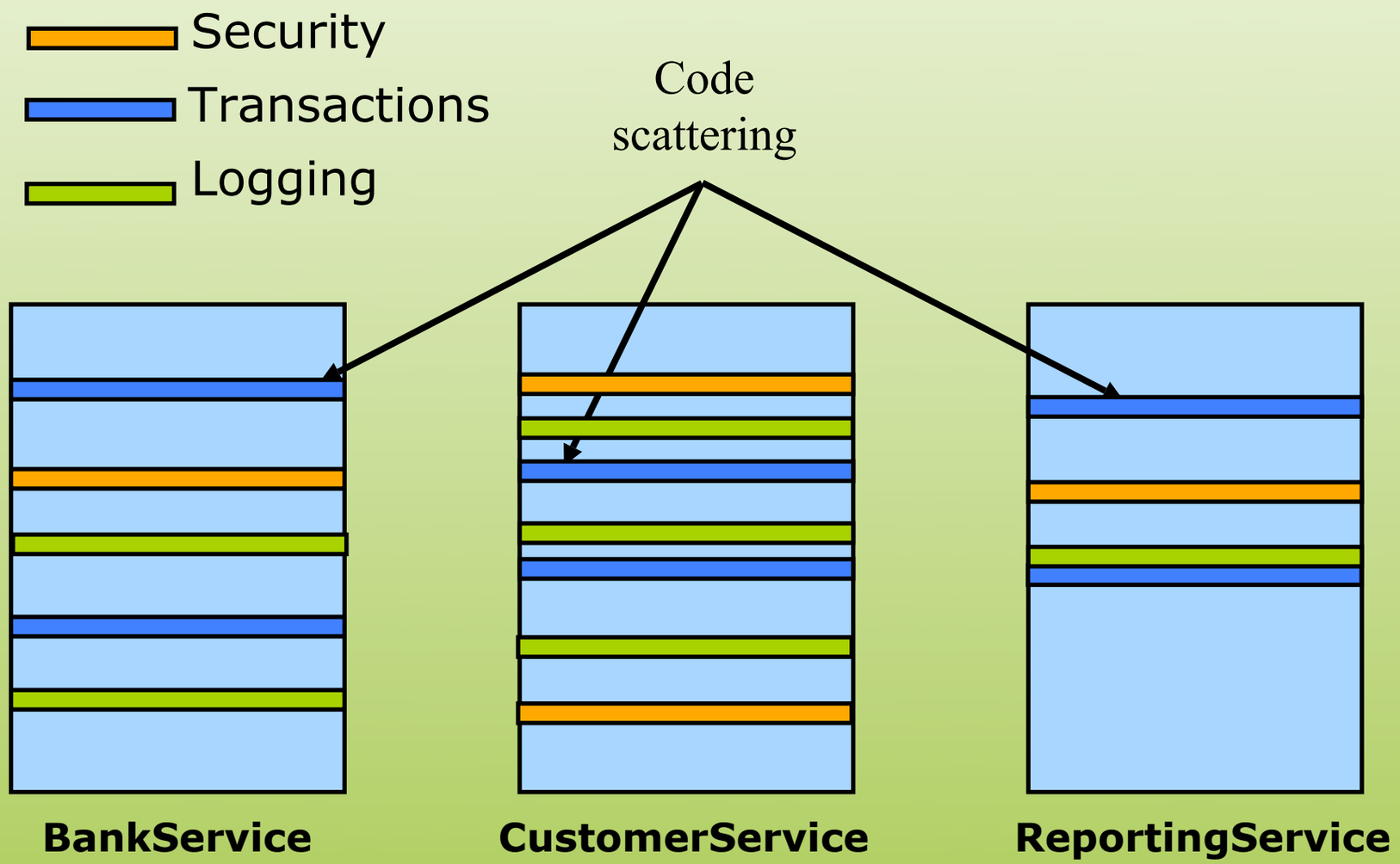
Security
Transactions
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Code scattering
BankService
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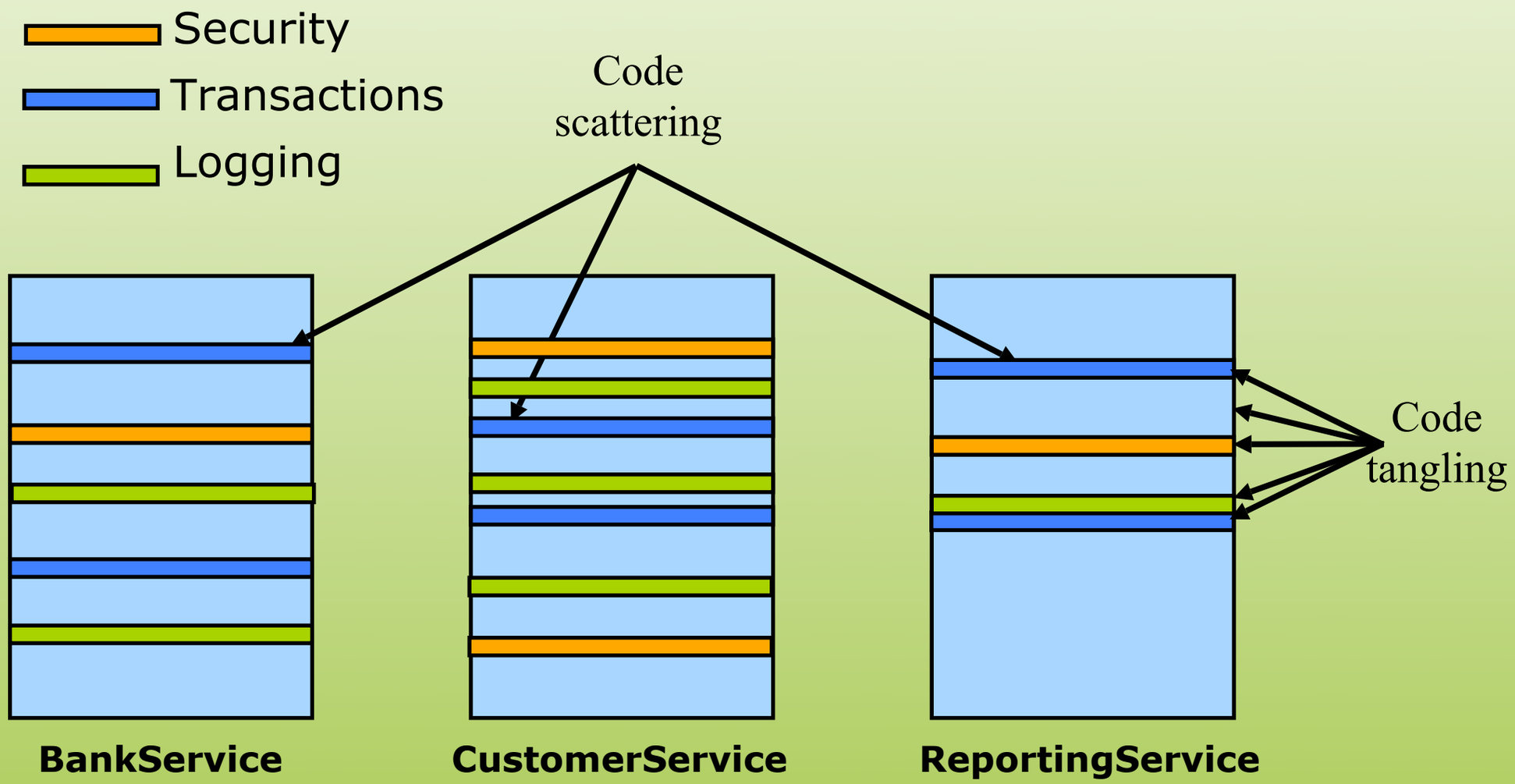
Without AOP


Security
Transactions
Logging
Code scattering
Code tangling
BankService
CustomerService
ReportingService

How AOP Works

1. Implement your mainline application logic
2. Write aspects to implement your cross-cutting concerns
3. Weave the aspects into your application

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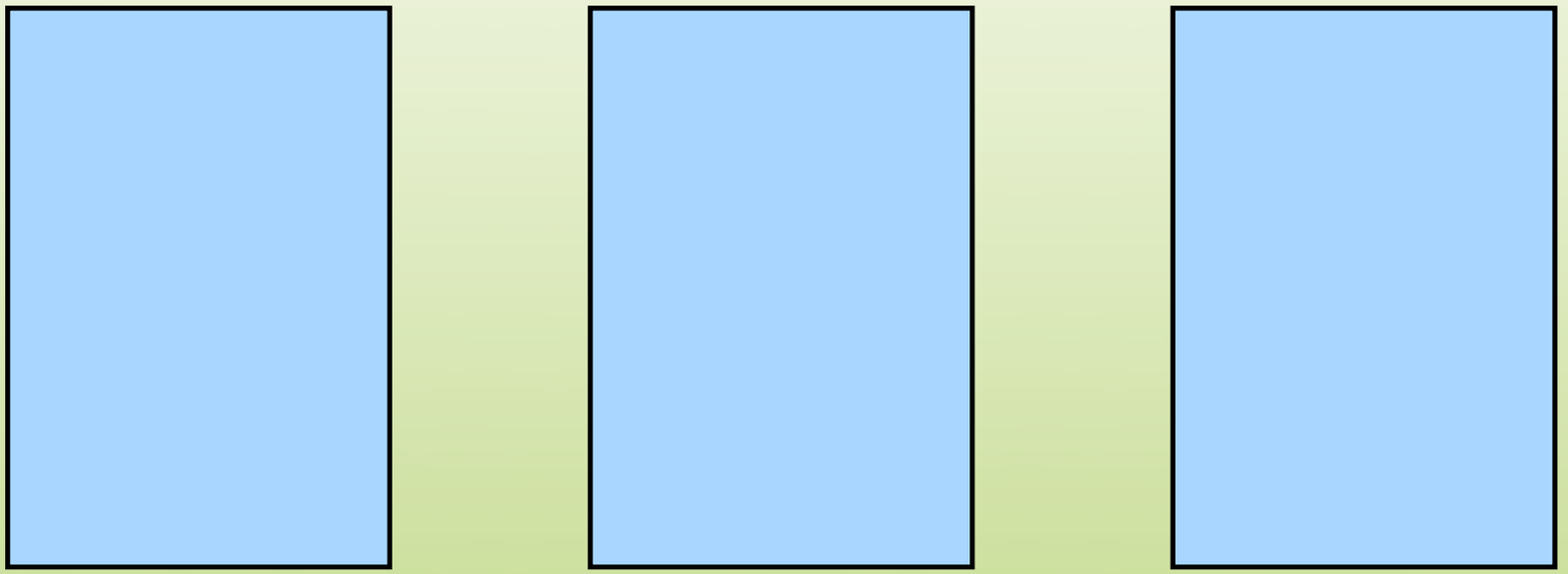
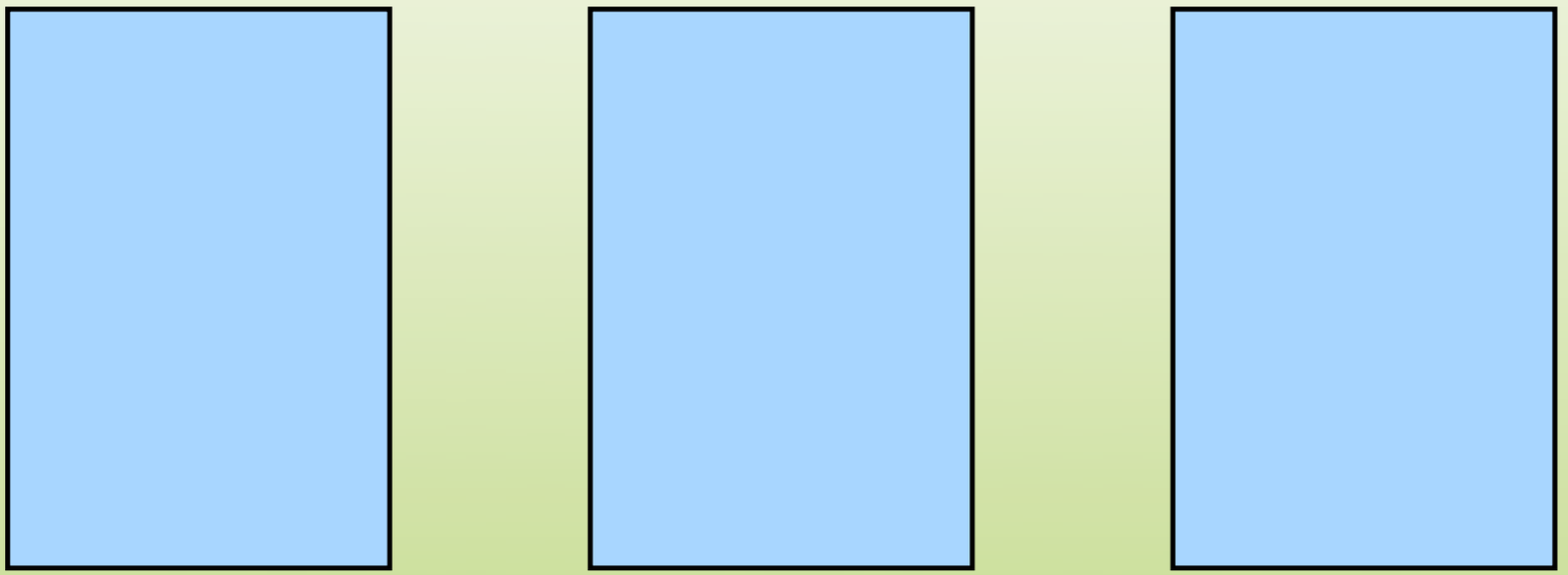
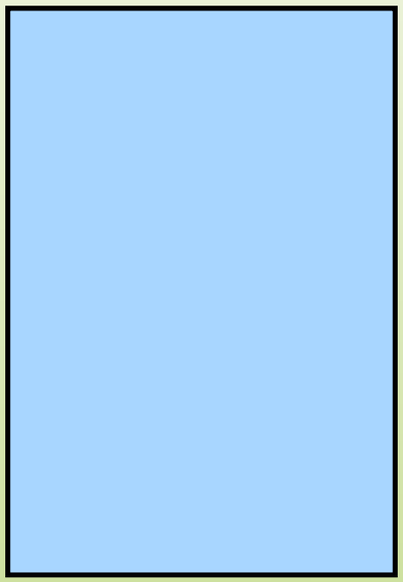
AOP based



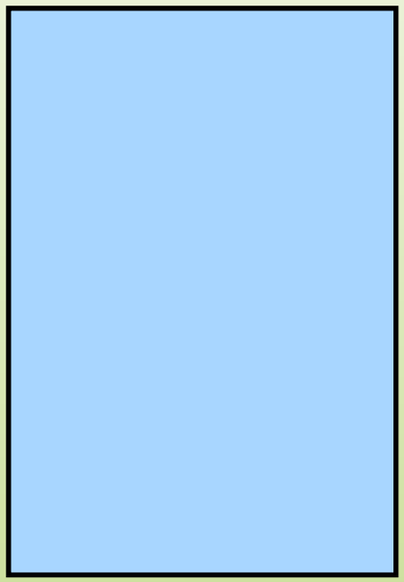
AOP based


BankService
CustomerService
ReportingService
Security
Aspect

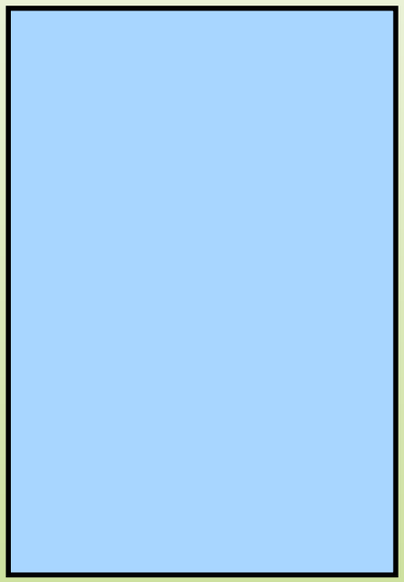
AOP based



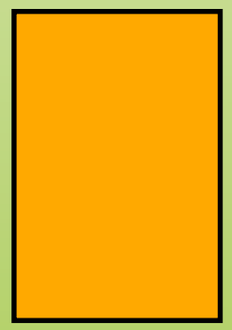
BankService



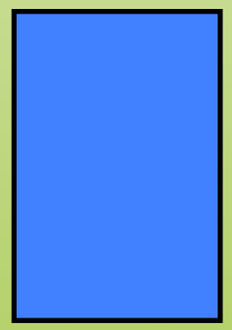
CustomerService



ReportingService

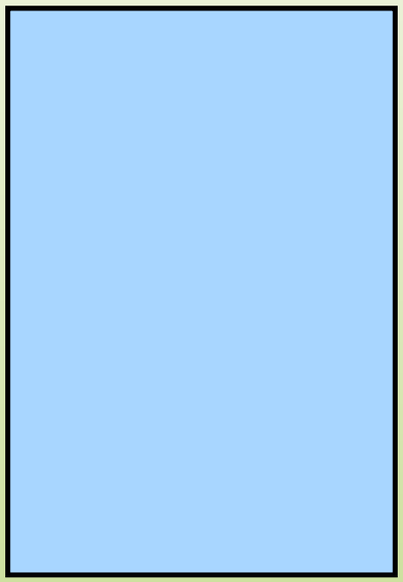


Security
Aspect

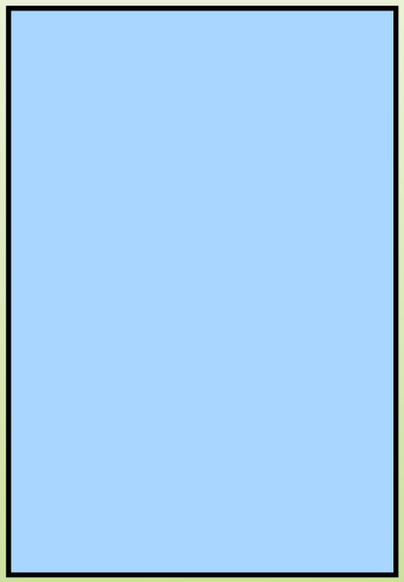


Transaction
Aspect

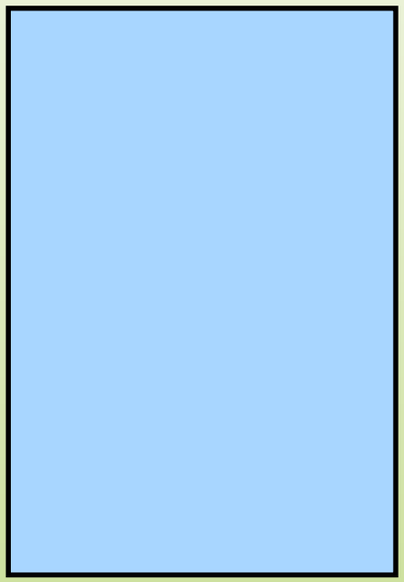
AOP based



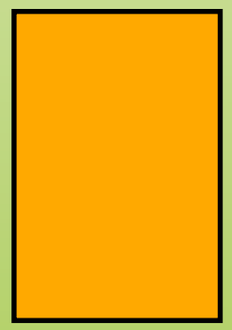
BankService



CustomerService



ReportingService



Security
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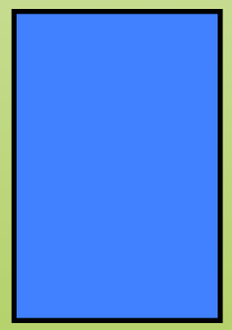
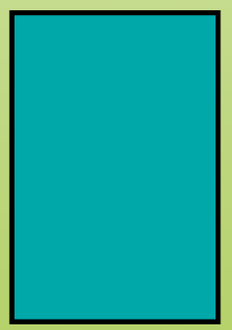
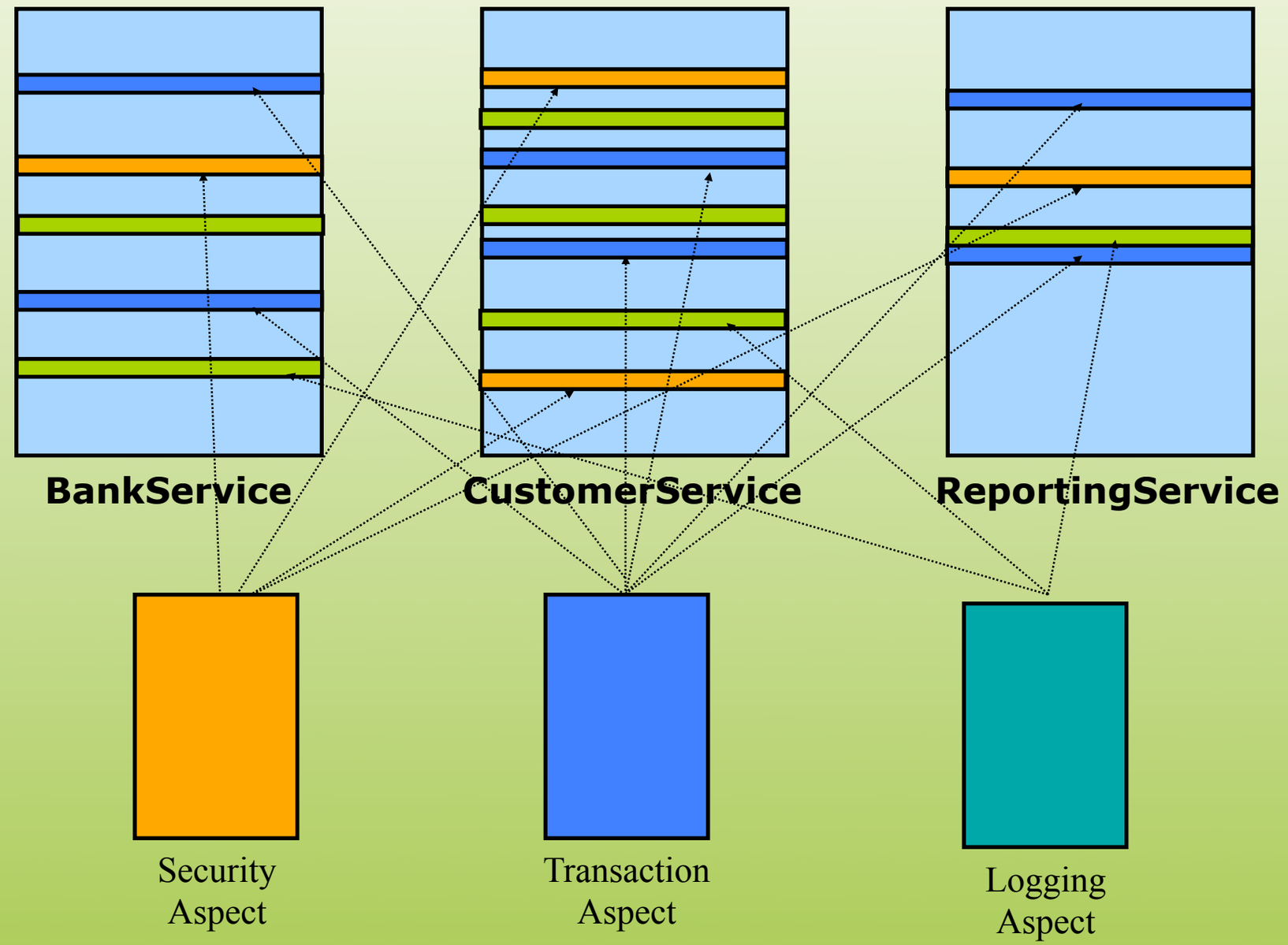


Transaction
Aspect



Logging
Aspect

AOP based


BankService
CustomerService
ReportingService
Security Aspect
Transaction Aspect
Logging Aspect

AOP Quick Start

- Consider this basic requirement

Log a message every time a property is about to change

- How can you use AOP to meet it?

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Target Object

```
public class SimpleCache implements Cache {
    private int cacheSize;
    private DataSource dataSource;

    public void setCacheSize(int size) {
        cacheSize = size;
    }

    public void setDataSource(DataSource ds) {
        dataSource = ds;
    }
    …
}
```

The Aspect

The Aspect

```
@Aspect
```

The Aspect

```
@Aspect
public class PropertyChangeTracker {
```

The Aspect

```
@Aspect
public class PropertyChangeTracker {
    private Logger logger = Logger.getLogger(getClass());
```

The Aspect

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@Aspect
public class PropertyChangeTracker {
    private Logger logger = Logger.getLogger(getClass());
```

The Aspect

```
@Aspect
public class PropertyChangeTracker {
    private Logger logger = Logger.getLogger(getClass());

    @Before("execution(void set*(*))")
```

The Aspect

```
@Aspect
public class PropertyChangeTracker {
    private Logger logger = Logger.getLogger(getClass());

    @Before("execution(void set*(*))")
    public void trackChange() {
```

The Aspect

```
@Aspect
public class PropertyChangeTracker {
    private Logger logger = Logger.getLogger(getClass());

    @Before("execution(void set*(*))")
    public void trackChange() {
        logger.info("Property about to change…");
```

The Aspect

```
@Aspect
public class PropertyChangeTracker {
    private Logger logger = Logger.getLogger(getClass());

    @Before("execution(void set*(*))")
    public void trackChange() {
        logger.info("Property about to change…");
    }
```

The Aspect

```
@Aspect
public class PropertyChangeTracker {
    private Logger logger = Logger.getLogger(getClass());

    @Before("execution(void set*(*))")
    public void trackChange() {
        logger.info("Property about to change…");
    }
}
```

Tell Spring about the Aspect

```
<beans>

    <aop:aspectj-autoproxy/>

    <bean id=“propertyChangeTracker” class=“example.PropertyChangeTracker” />

    <bean name=“cache-A” class=“example.SimpleCache” ../>
    <bean name=“cache-B” class=“example.SimpleCache” ../>
    <bean name=“cache-C” class=“example.SimpleCache” ../>

</beans>
```

Run...

```
ApplicationContext context =
    new ClassPathXmlApplicationContext("application-config.xml");
Cache cache = (Cache) context.getBean("cache-A");
cache.setCacheSize(2500);
```

Run...

```
ApplicationContext context =
    new ClassPathXmlApplicationContext("application-config.xml");
Cache cache = (Cache) context.getBean("cache-A");
cache.setCacheSize(2500);
```

```
INFO: Property about to change…
```

Reason #5

@Transactional

Why use Transactions?

- Atomic
  - Each unit of work is an all-or-nothing operation
- Consistent
  - Database integrity constraints are never violated
- Isolated
  - Uncommitted changes are not visible to other transactions
- Durable
  - Committed changes are permanent

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Local Transaction Management

- Transactions can be managed at the level of a local resource
  - Such as the database
- Requires programmatic management of transactional behavior on the Connection

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Example

```
public void updateBeneficiaries(Account account) {
...
    try {
        conn = dataSource.getConnection();
        conn.setAutoCommit(false);
        ps = conn.prepareStatement(sql);
        for (Beneficiary b : account.getBeneficiaries()) {
            ps.setBigDecimal(1, b.getSavings().asBigDecimal());
            ps.setLong(2, account.getEntityId());
            ps.setString(3, b.getName());
            ps.executeUpdate();
        }
        conn.commit();
    } catch (Exception e) {
        conn.rollback();
        throw new RuntimeException("Error updating!", e);
    }
```

Problems with Local Transactions

- Connection management code is error-prone
- Transaction demarcation belongs at the service layer
  - Multiple data access methods may be called within a transaction
  - Connection must be managed at a higher level

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Passing Connections

```
public RewardConfirmation rewardAccountFor(Dining dining) {
    Connection conn = DataSourceUtils.getConnection();
    conn.setAutoCommit(false);
    try {
        ...
        accountRepository.updateBeneficiaries(account, conn);
        rc = rewardRepository.confirmReward(contrib, dining, conn);
        conn.commit();
    }
    catch (Exception e) {
        conn.rollback();
        throw new RuntimeException("reward failed", e);
    }
}
```

Programmatic JTA

- Application Servers enable use of the Java Transaction API (JTA)
  - The UserTransaction object is bound to JNDI
- Transactions can be managed from the service layer
  - May call multiple data access methods

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JTA

```
public RewardConfirmation rewardAccountFor(Dining dining) {
   Context ctx = new InitialContext();
   UserTransaction transaction = (UserTransaction)
                                        ctx.lookup("java:comp/UserTransaction");
   transaction.begin();
   try {
      ...
      accountRepository.updateBeneficiaries(account);
      confirmation = rewardRepository.confirmReward(contribution, dining);
      transaction.commit();
   }
   catch (Exception e) {
      transaction.rollback();
      throw new RuntimeException("failed to reward", e);
   }
}
```

Programmatic JTA Problems

- Depends on an Application Server environment
- Still requires code to manage transactions
- The code is error-prone

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@Transactional

```
public class RewardNetworkImpl implements RewardNetwork {
   @Transactional
   public RewardConfirmation rewardAccountFor(Dining d) {
      // atomic unit-of-work
   }
}
```

@Transactional

- Works though AOP
- Consistent approach
  - JDBC
  - JPA
  - Hibernate
  - JMS
  - JTA
  - ...

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Reason #6

Scripting Languages

Scripting Languages

- More and more popular
- Especially when running on the JVM
- Mix-and-match approach
  - Front-end in JRuby
  - Back-end in Java

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Dynamic Language Support in Spring

- Spring container supports
  - Groovy
  - JRuby
  - BeanShell

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JRuby

```
package org.springframework.scripting;

public interface Messenger {

    String getMessage();
}
```

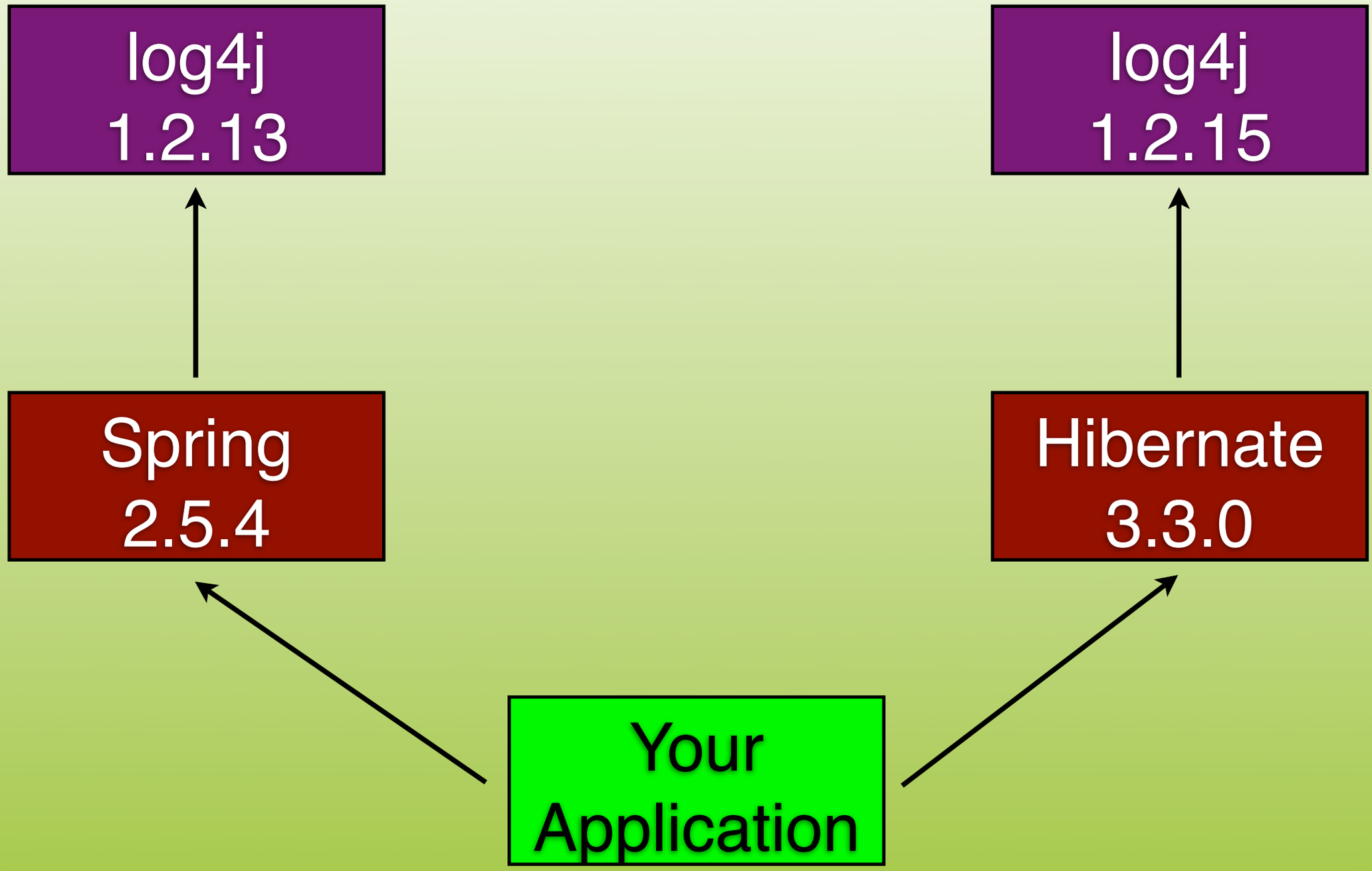
```
require 'java'

class RubyMessenger
    include org.springframework.scripting.Messenger

    def setMessage(message)
        @@message = message
    end

    def getMessage
        @@message
    end
end
```

```
<lang:jruby id="messageService"
            script-interfaces="org.springframework.scripting.Messenger"
            script-source="classpath:RubyMessenger.rb">

    <lang:property name="message" value="Hello World!" />

</lang:jruby>
```

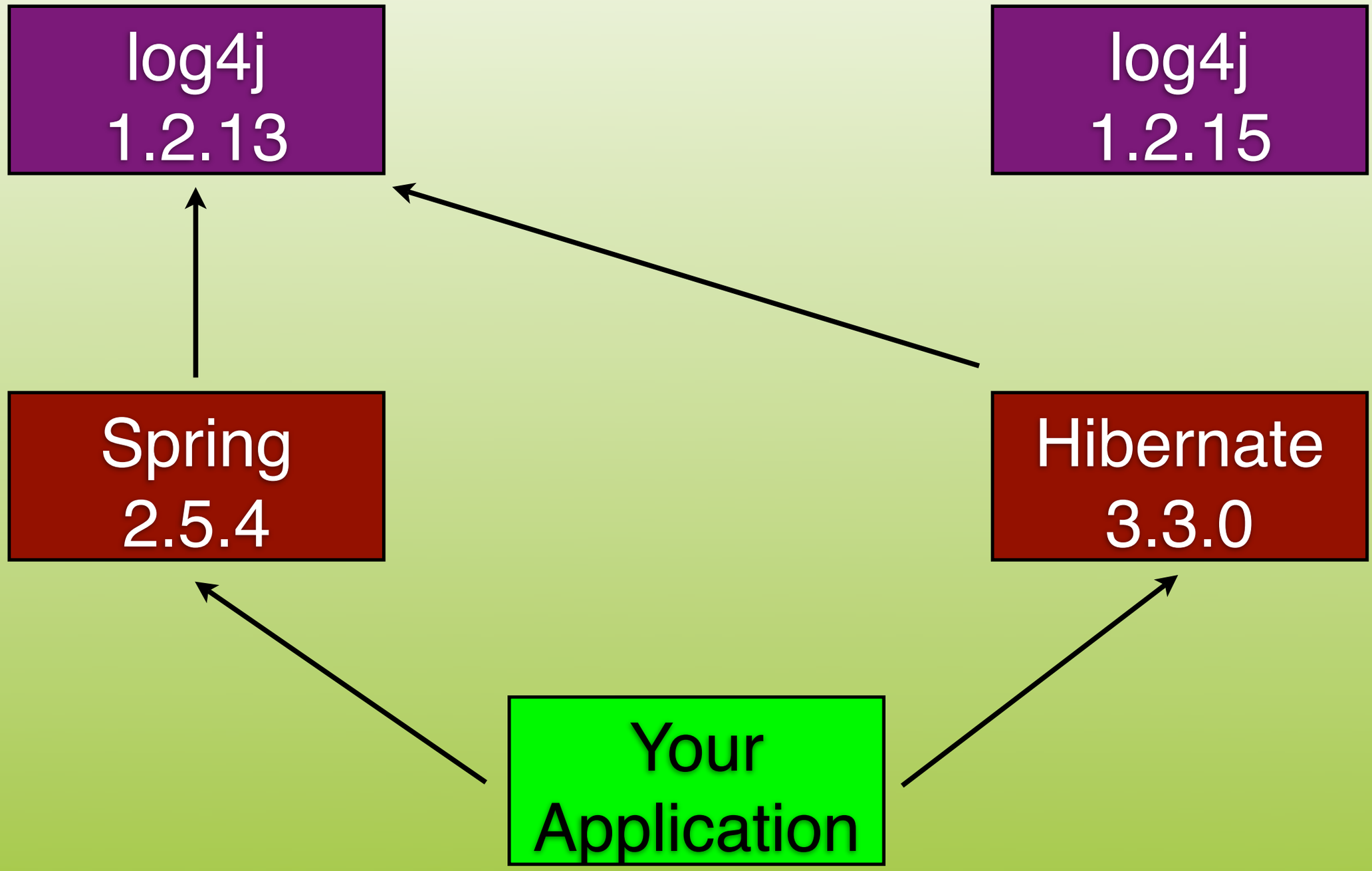
Reason #7

OSGi

JAR Hell


log4j
1.2.13
log4j
1.2.15
Spring
2.5.4
Hibernate
3.3.0
Your
Application

JAR Hell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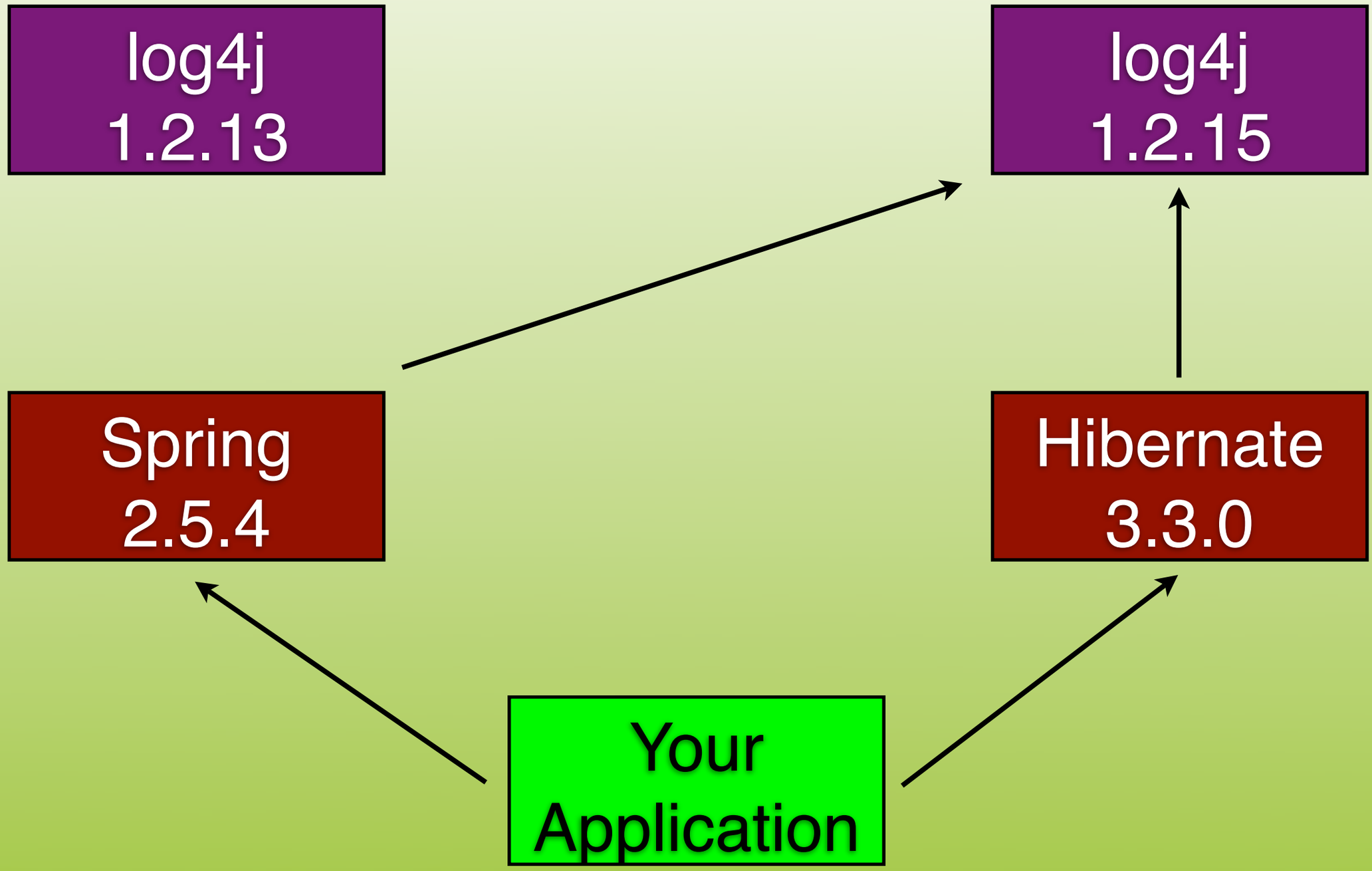
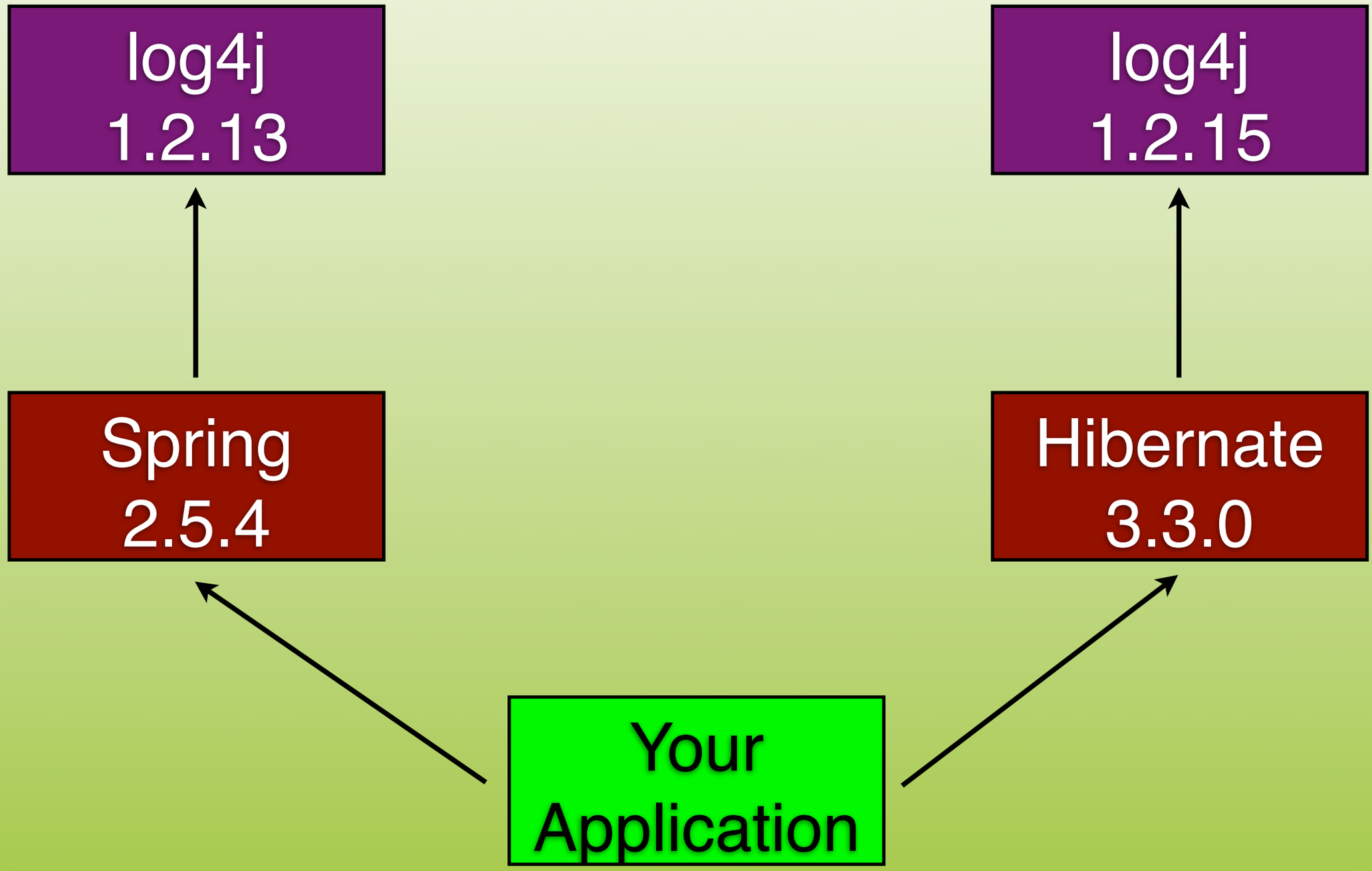
JAR Hell


log4j
1.2.13
log4j
1.2.15
Spring
2.5.4
Hibernate
3.3.0
Your
Application

OSGi


log4j
1.2.13
log4j
1.2.15
Spring
2.5.4
Hibernate
3.3.0
Your
Application

OSGi

log4j
1.2.13

log4j
1.2.15

```
MANIFEST.MF
Import-package:
  org.apache.log4j;
  version=1.2.13
```

S
2.5.4

Hibernate
3.3.0

Your
Application

OSGi

log4j
1.2.13

log4j
1.2.15

```
MANIFEST.MF
Import-package:
  org.apache.log4j;
  version=1.2.13
```

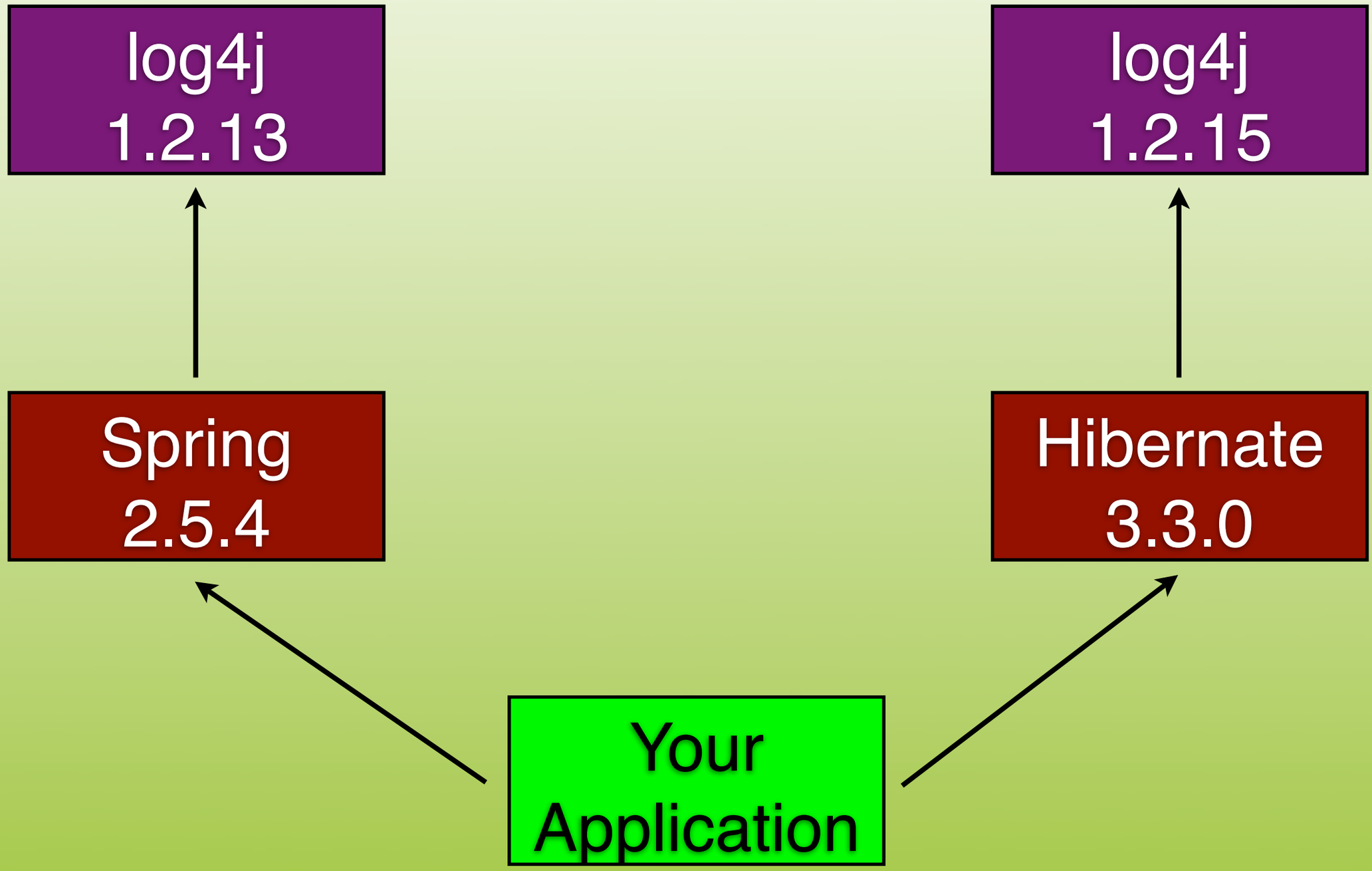
```
MANIFEST.MF
Import-package:
  org.apache.log4j;
  version=1.2.15
```

S
2.5.4

ate
3.3.0

Your
Application

OSGi


log4j
1.2.13
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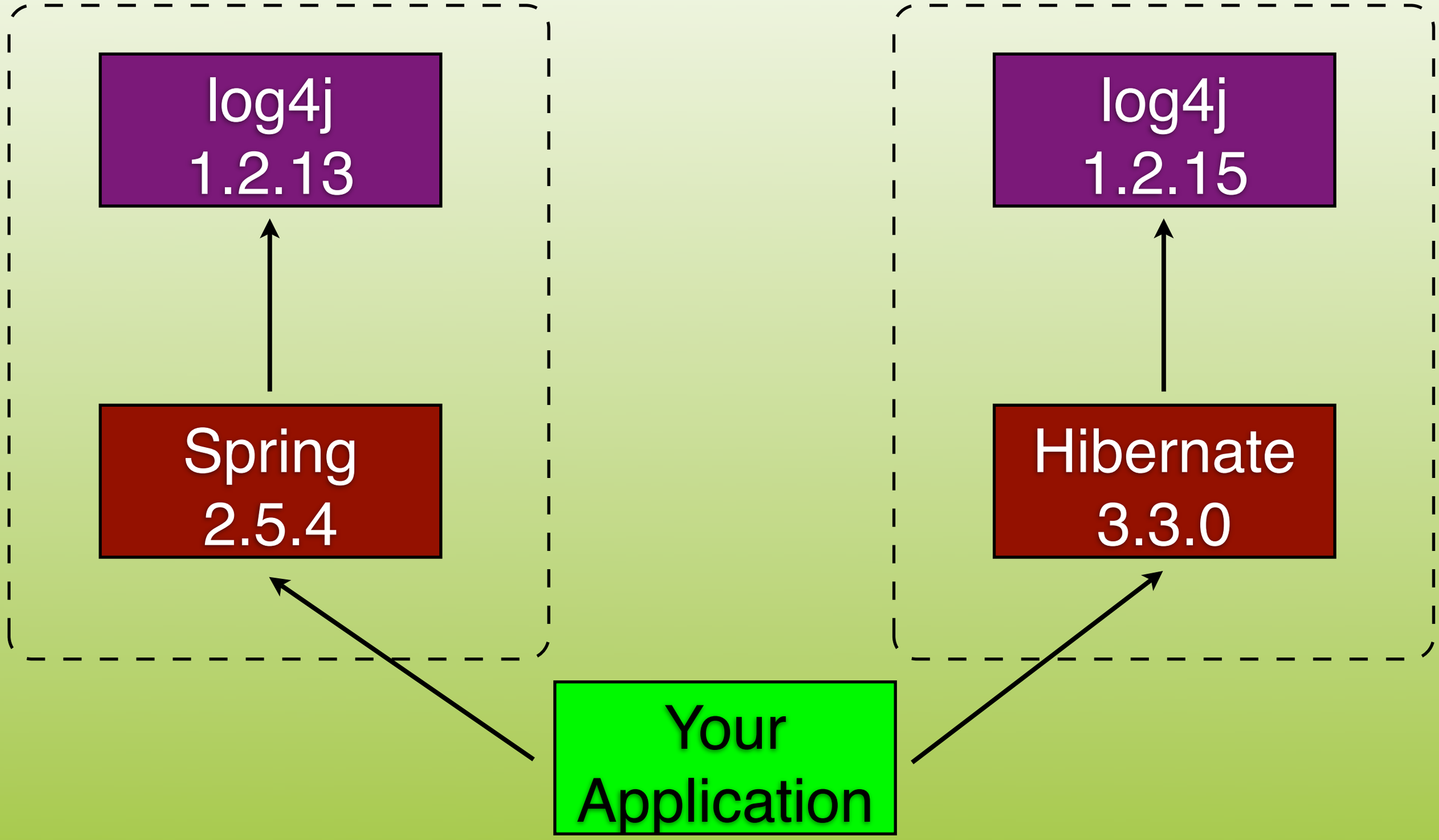
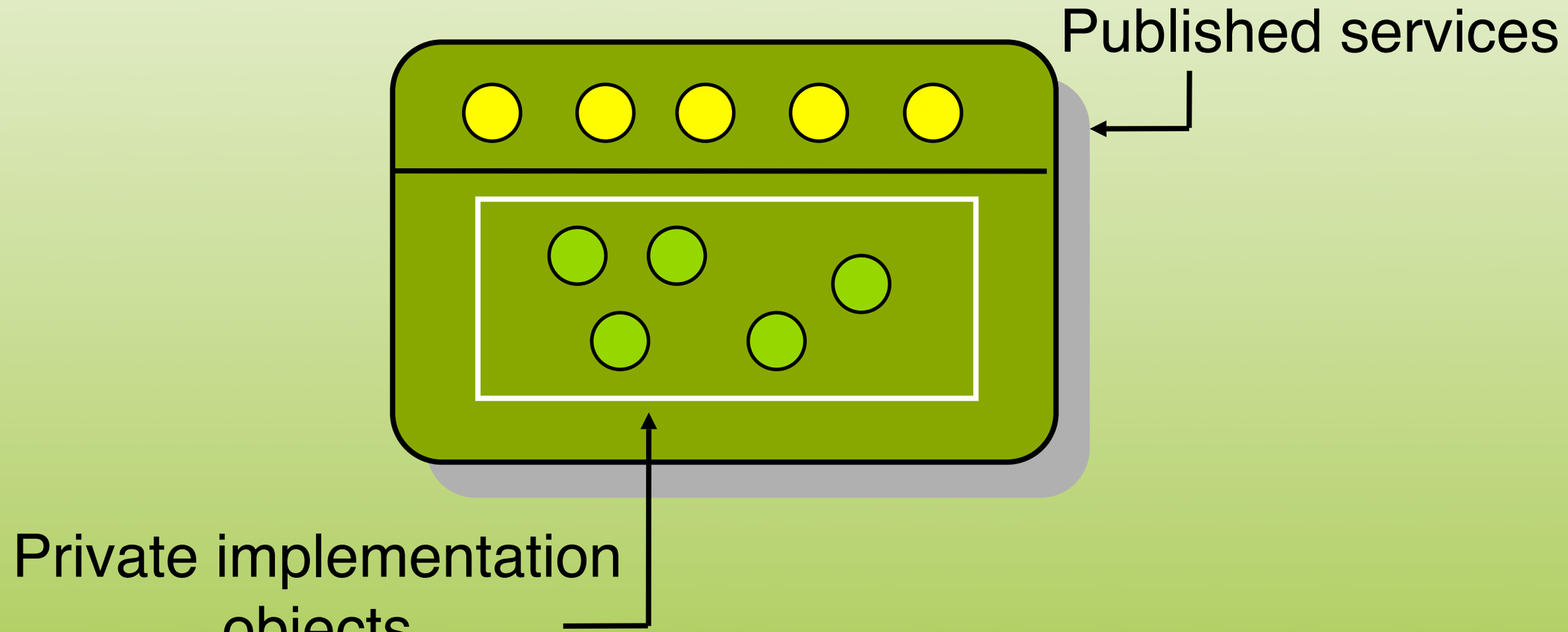
Your
Application

OSGi


log4j
1.2.13
Spring
2.5.4
log4j
1.2.15
Hibernate
3.3.0
Your
Application

OSGi Service contribution



OSGi^{tm} – Dynamic System for Java

- Partition an app into modules
  - Module = Bundle = Jar = a set of classes
- Each module has its own:
  - class space
  - lifecycle
- Strict visibility rules
- Understands versioning
- Everything is *Dynamic*!

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OSGi

- Import specific versions of dependencies
- Export as services

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Spring Dynamic Modules

- Decorate objects as OSGi services
- Dependency injection for OSGi services
- Remove OSGi dependencies
- Easier to test

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Exporting OSGi Service

```
<bean id="myPojo" class="someObject"/>

<osgi:service

  ref="myPojo"

  interface= "com.springsource.MyService"/>
```


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Importing OSGi service

```
<osgi:reference
   id="osgiService"
   interface="com.springsource.DynamicService"/>

<bean id="consumer" class..>
   <property name="service" ref="osgiService">
</bean>
```


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But wait, there is more!

- There is more!
  - JMS, Web, Security, Web Services, Batch, Integration, ...
- Check out www.springframework.org

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Q & A