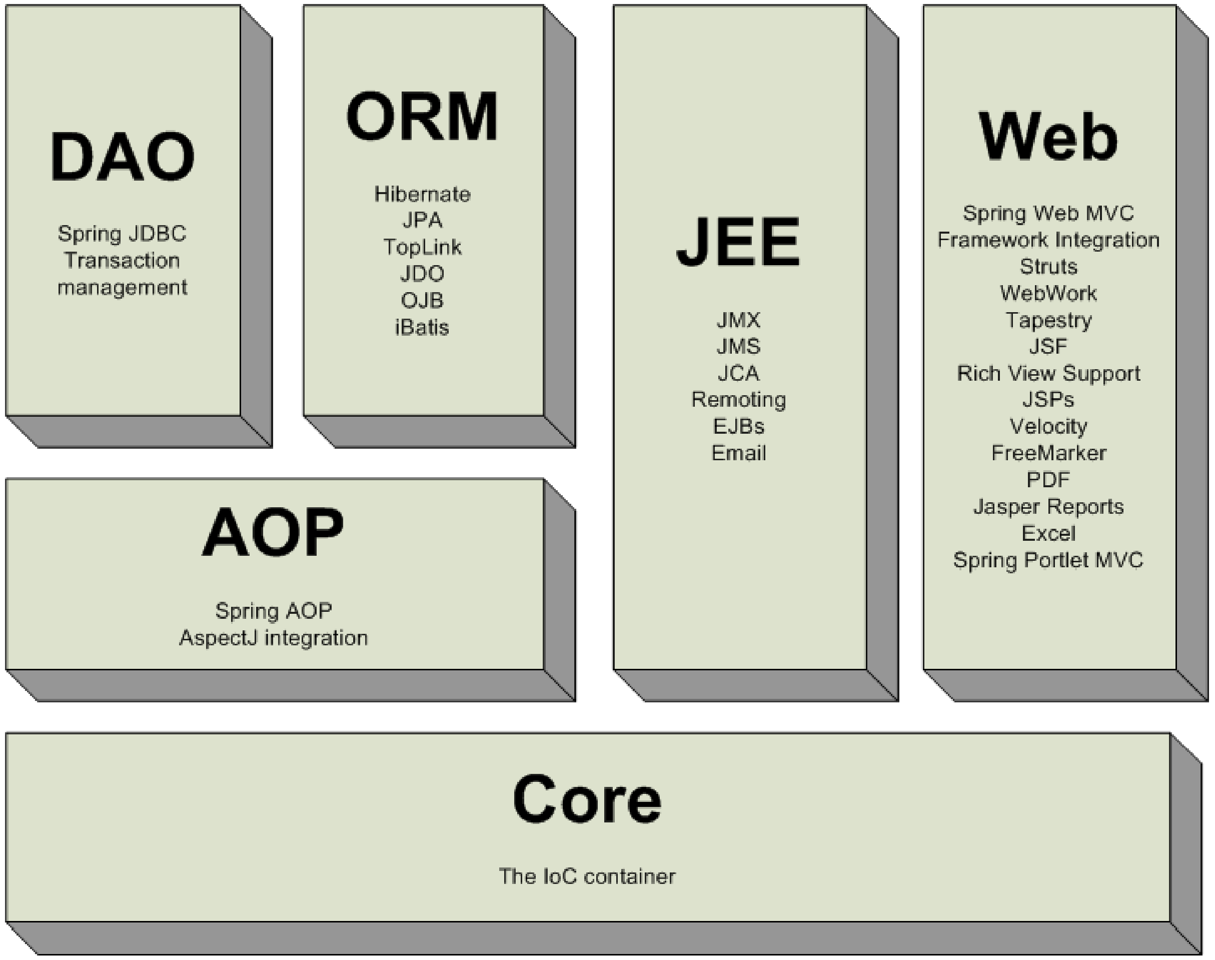
Spring

and

the IoC Container

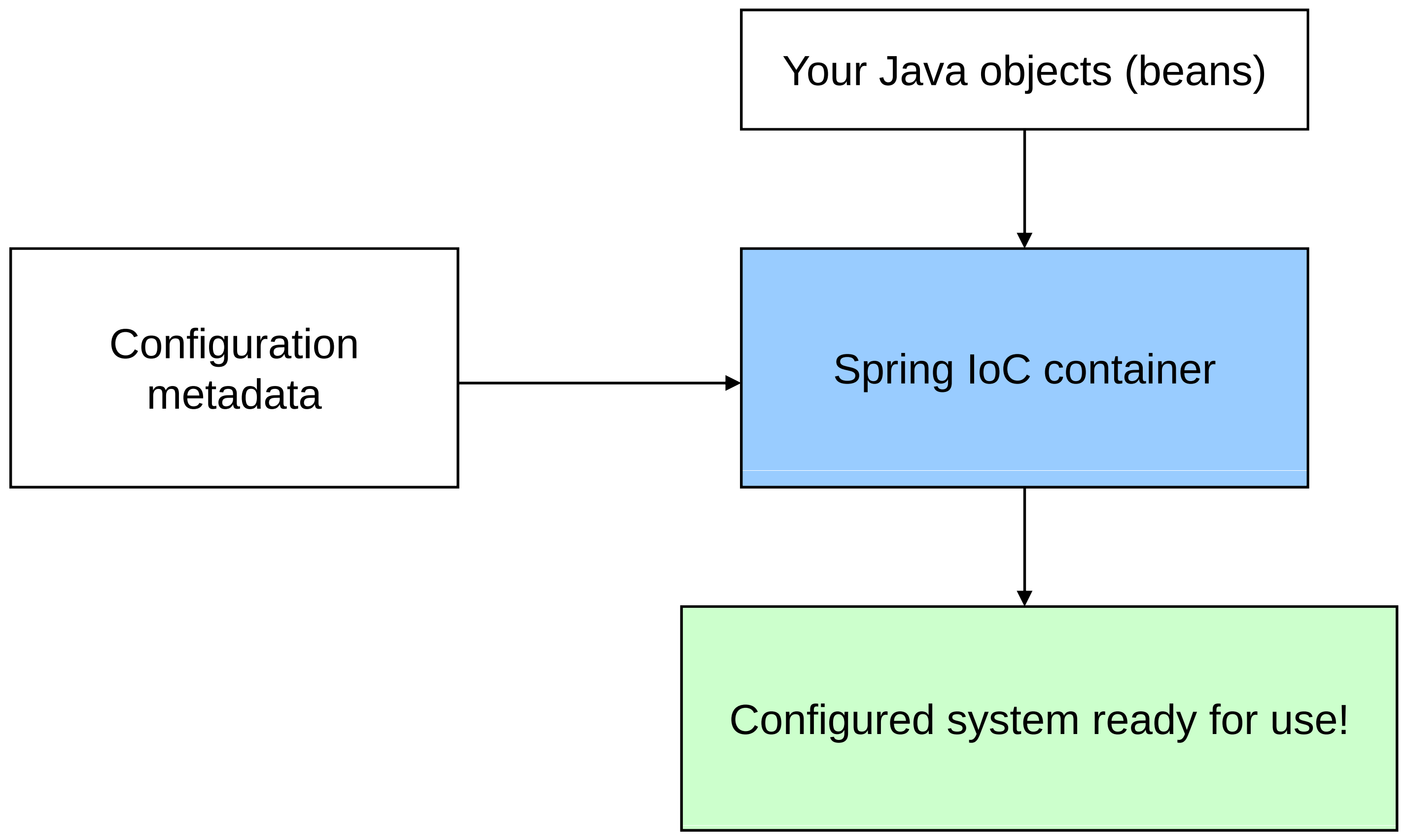
Spring overview



The IoC container

- IoC means *Inversion of Control* (Dependency Injection)
- The *IoC container* is the core component of the Spring framework
- A *bean* is an object that is managed by the IoC container
- The IoC container is responsible for containing and managing beans
- Spring comes with two types of containers
  - BeanFactory
  - ApplicationContext

The IoC container



The BeanFactory

- Provides basic support for dependency injection
- Responsible for
  - Creating and dispensing beans
  - Managing dependencies between beans
- Lightweight – useful when resources are scarce
  - Mobile applications, applets
- *XMLBeanFactory* most commonly used implementation

```
Resource xmlFile = new ClassPathResource( "META-INF/beans.xml" );
BeanFactory beanFactory = new XmlBeanFactory( xmlFile );
```

```
MyBean myBean = (MyBean) beanFactory.getBean( ”myBean” );
```

The ApplicationContext

- Built on top of the BeanFactory
- Provides more enterprise-centric functionality
  - Internationalization of messages
  - AOP, transaction management
- Preferred over the BeanFactory in most situations
- Most commonly used implementation is the *ClassPathXmlApplicationContext*

```
String xmlFilePath = "META-INF/beans.xml”;

ApplicationContext context = new ClassPathXmlApplicationContext( xmlFilePath );
```

```
MyBean myBean = (MyBean) context.getBean( ”myBean” );
```

Convenient container instantiation

- ApplicationContext instances can be created declaratively in web.xml using a ContextLoader

Points to the Spring configuration file

```
<context-param>
   <param-name>contextConfigLocation</param-name>
   <param-value>classpath*:/META-INF/beans.xml</param-value>
</context-param>

<listener>
   <listener-class>org.springframework.web.context.ContextLoaderListener</listener-class>
</listener>
```

ContextLoaderListener definition. The listener will inspect the contextConfigLocation parameter.

Dependencies

- The container injects dependencies when it creates a bean (the dependency injection principle)
- Setter-based dependency injection most convenient

```
public class DefaultStudentSystem implements StudentSystem
{
    private String studentDAO;

    public void setStudentDAO( StudentDAO studentDAO )
    {
        this.studentDAO = studentDAO;
    }
```

Dependency defined only through a reference and a public set-method

```
<bean id=”studentSystem”  class=”no.uio.inf5750.service.DefaultStudentSystem”>
    <property name=”studentDAO” ref bean=”studentDAO”/>
</bean>

<bean id=”studentDAO” class=”no.uio.inf5750.dao.HibernateStudentDAO”/>
```

StudentDAO injected into StudentService

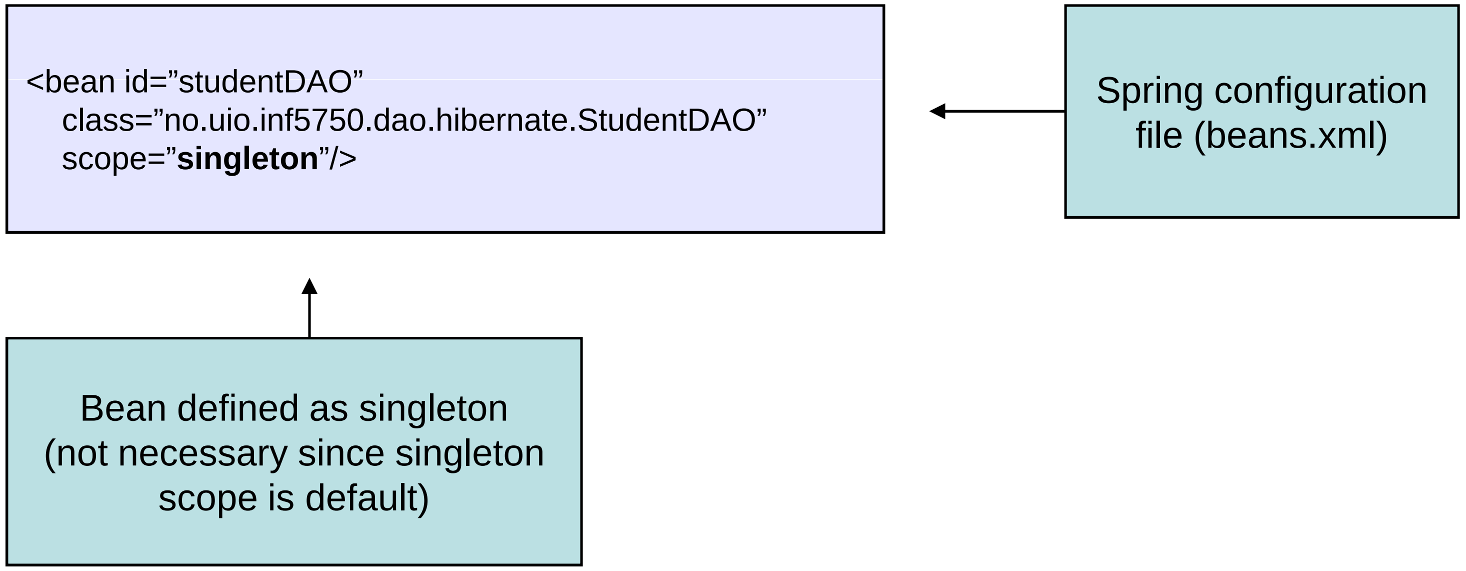
Bean scopes

- A bean definition is a *recipe* for creating instances
  - Many object instances can be created from a single definition
- Spring will manage the *scope* of the beans for you
  - No need for doing it programmatically

Scope	*Description*
singleton	Scopes a single bean definition to a single object instance.
prototype	Scopes a single bean definition to any number of object instances.

The singleton scope

- Only one shared instance will ever be created by the container
- The single bean instance will be stored in a cache and returned for all requests
- Singleton beans are created at container startup-time

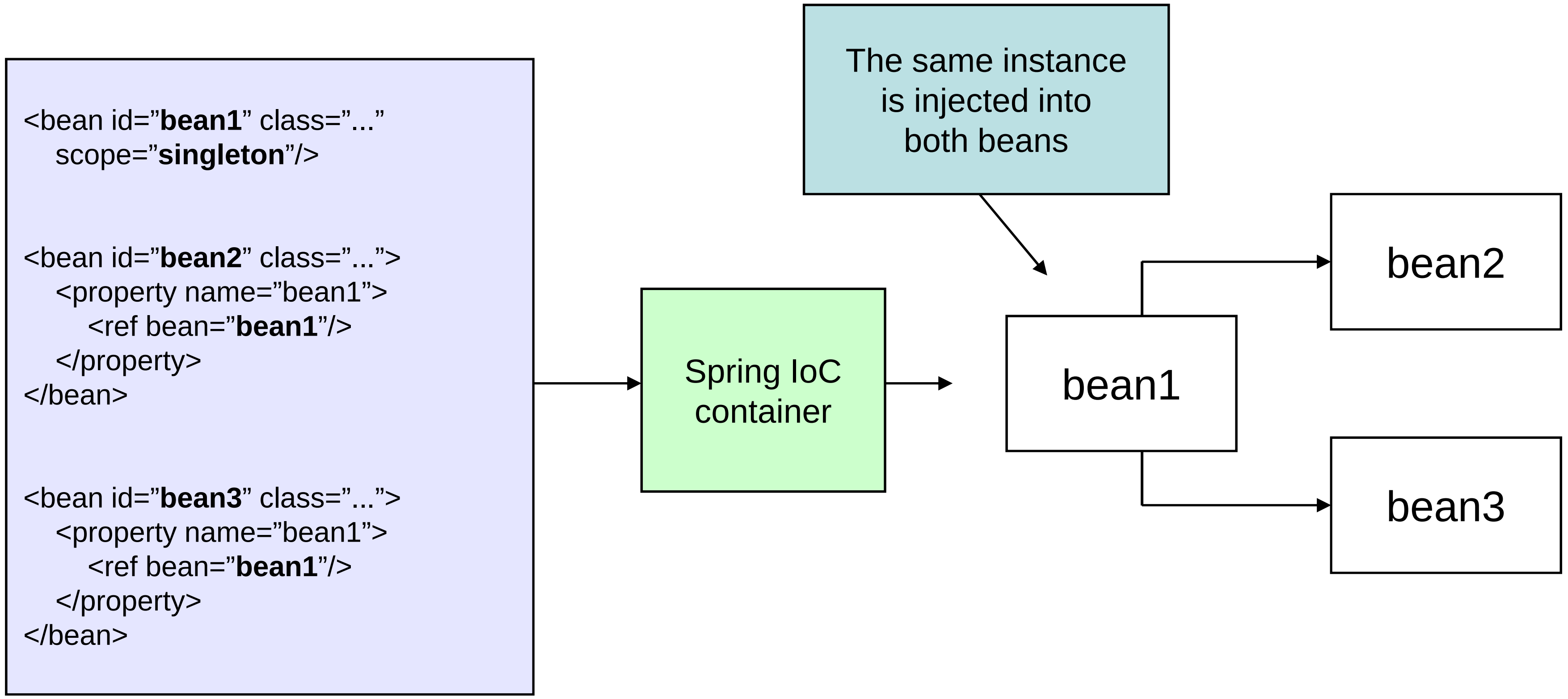


```
<bean id="studentDAO"
    class="no.uio.inf5750.dao.hibernate.StudentDAO"
    scope="singleton"/>
```

Spring configuration file (beans.xml)
Bean defined as singleton (not necessary since singleton scope is default)

The singleton scope

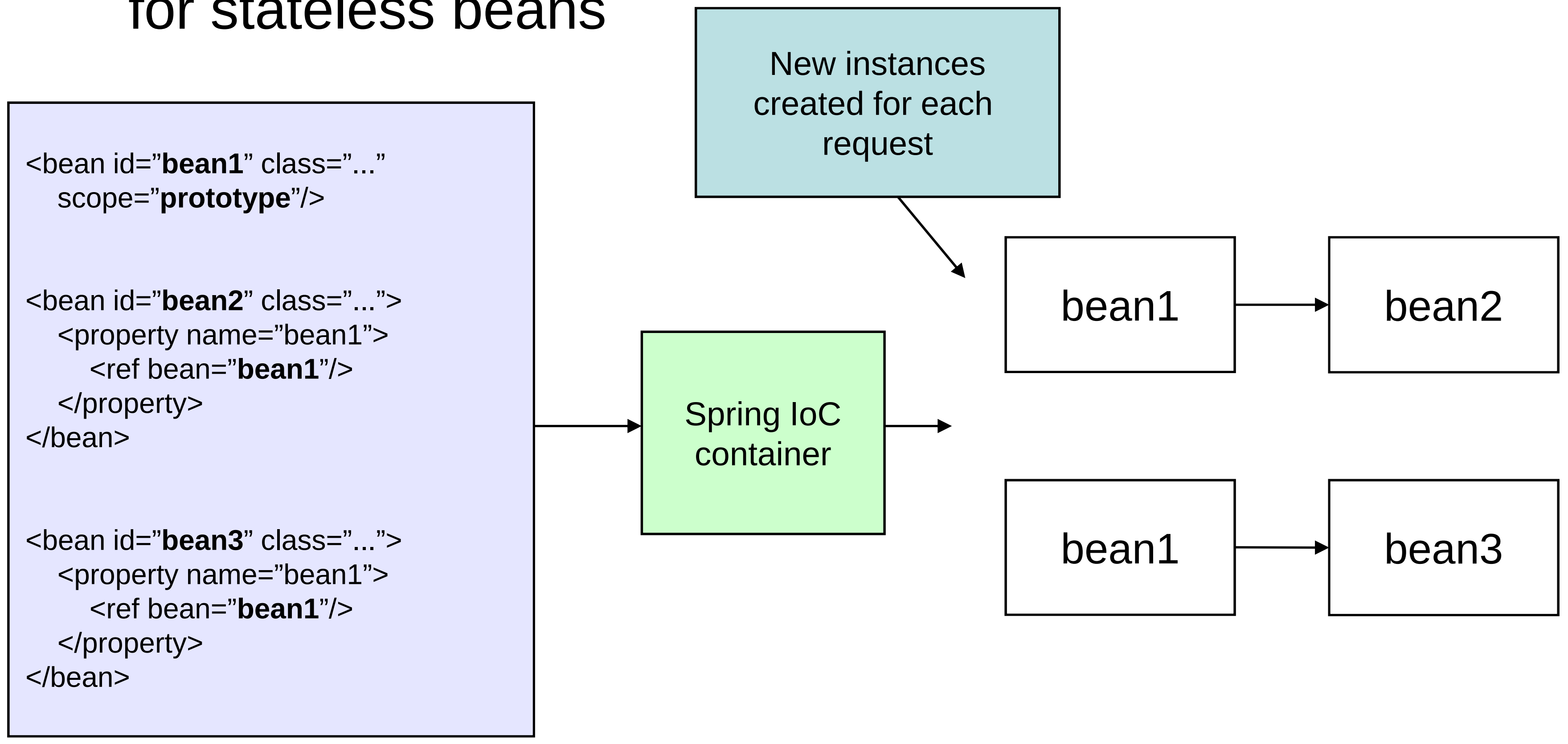
- Singleton per container – not by classloader
- Singleton is default scope in Spring



```
<bean id="bean1" class="..."
    scope="singleton"/>

<bean id="bean2" class="...">
    <property name="bean1">
        <ref bean="bean1"/>
    </property>
</bean>

<bean id="bean3" class="...">
    <property name="bean1">
        <ref bean="bean1"/>
    </property>
</bean>
```

The prototype scope

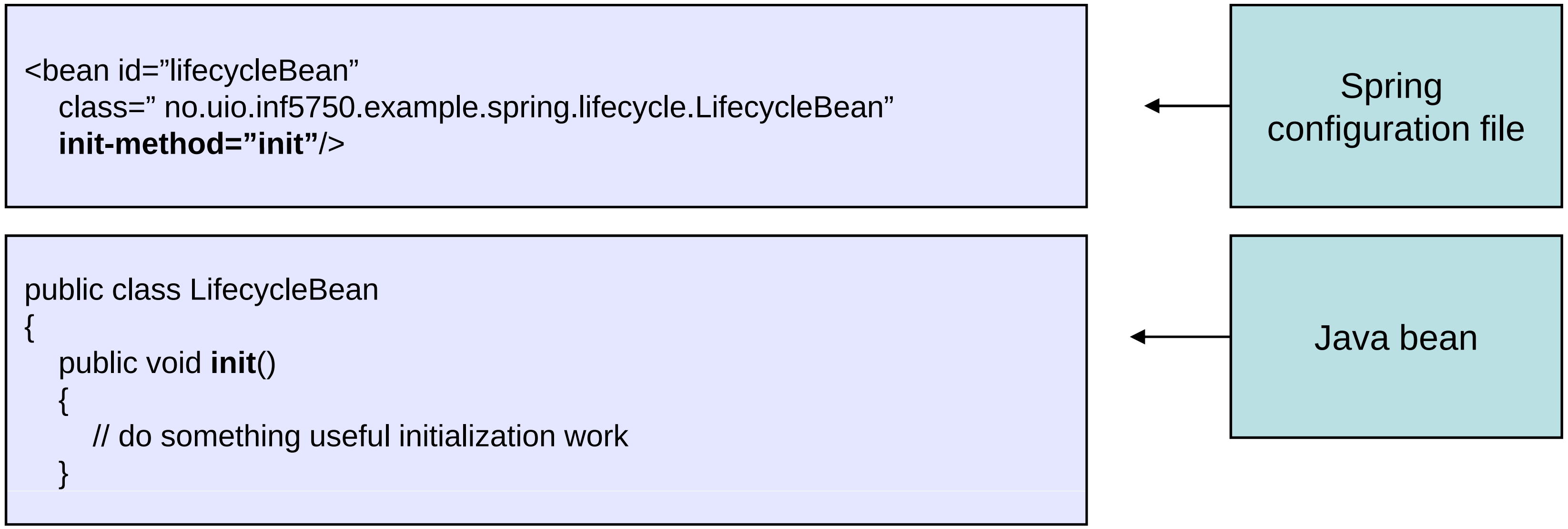
- A new bean instance will be created for each request
- Use prototype scope for stateful beans – singleton scope for stateless beans



```
<bean id=”bean1” class=”...”
    scope=”prototype”/>


<bean id=”bean2” class=”...”>
    <property name=”bean1”>
        <ref bean=”bean1”/>
    </property>
</bean>


<bean id=”bean3” class=”...”>
    <property name=”bean1”>
        <ref bean=”bean1”/>
    </property>
</bean>
```

Customizing the lifecycle of a bean

- Spring lets you define callback methods which are invoked at bean initialization and destruction
- The *init* method will be invoked after all properties are set on the bean



```
<bean id=”lifecycleBean”
   class=” no.uio.inf5750.example.spring.lifecycle.LifecycleBean”
   init-method=”init”/>
```

```
public class LifecycleBean
{
   public void init()
   {
      // do something useful initialization work
   }
```

Customizing the lifecycle of a bean

- The *destroy* method will be invoked when the container containing the bean is destroyed (not prototypes)
  - Most relevant in desktop applications
- Default lifecycle methods can be defined in the config

```
<bean id=”lifecycleBean”
   class=” no.uio.inf5750.example.spring.lifecycle.LifecycleBean”
   destroy-method=”destroy”/>
```

Spring configuration file

```
public class LifecycleBean
{
   public void destroy()
   {
      // do some useful destruction work
   }
```

Java bean

Internationalization

- Internationalization (i18n) is the process of decoupling the application from any specific locale
- Makes it possible to display messages in the user’s native language
- The ApplicationContext extends the MessageSource interface which provides i18n functionality
- Most commonly used implementation is the provided *ResourceBundleMessageSource*

The SaluteService

```
<bean id="messageSource"
    class="org.springframework.context.support.ResourceBundleMessageSource">
    <property name="basename" value="i18n"/>
</bean>

<bean id="saluteService"
    class="no.uio.inf5750.example.spring.i18n.DefaultSaluteService">
    <property name="messages" ref="messageSource"/>
</bean>
```

Spring looks for a bean called *messageSource*

Basename for the resourcebundles to use

MessageSource injected into DefaultSaluteService

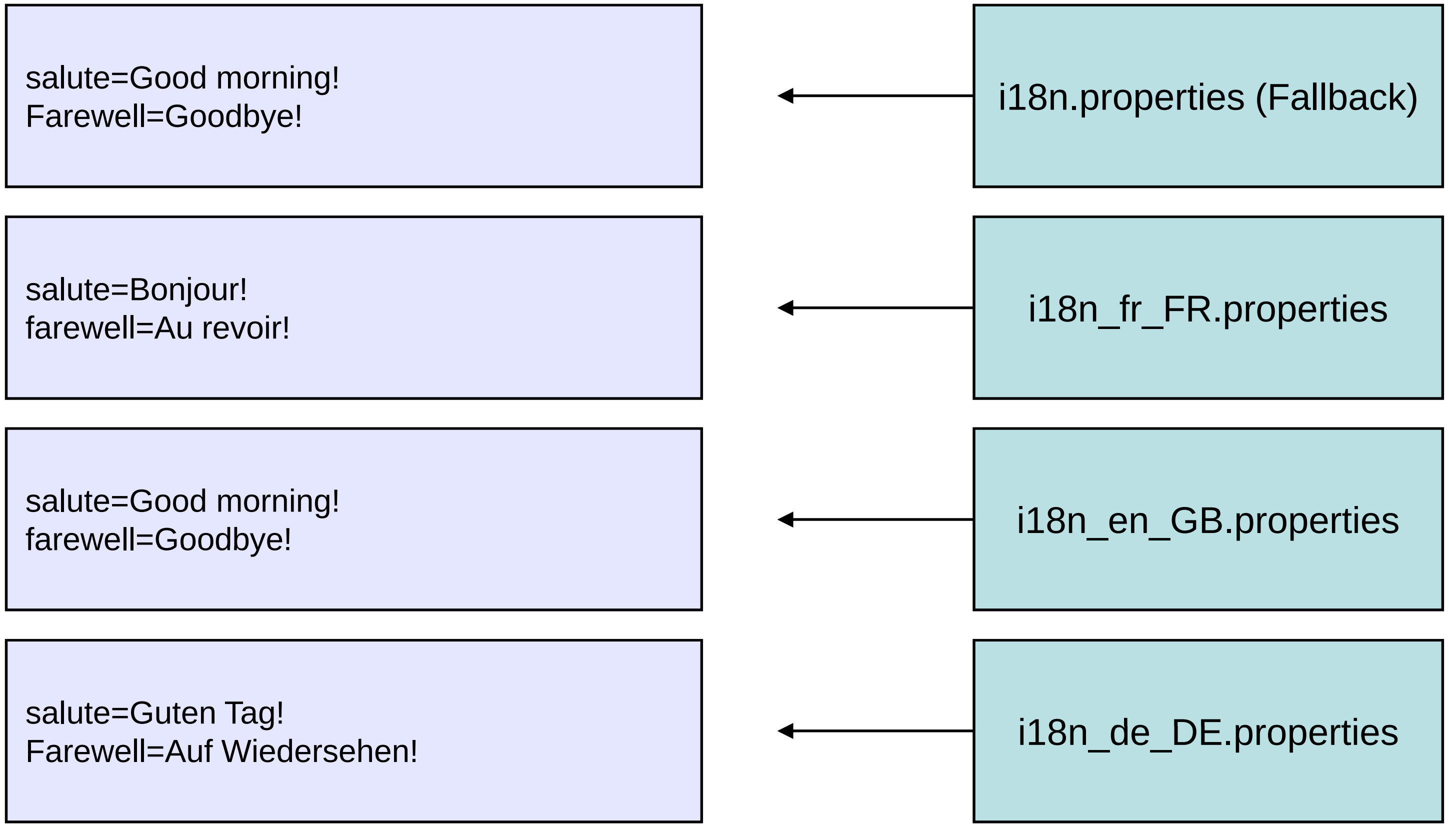
```
public class DefaultSaluteService implements SaluteService
{
    private MessageSource messages;

    // set-method for messages

    public String salute()
    {
        return messages.getMessage( "salute", null, locale );
    }
```

getMessage is invoked

param1: property key
param2: arguments
param3: Locale

The SaluteService

- MessageResource follows the the locale resolution and fallback rules of the standard JDK ResourceBundle



i18n.properties (Fallback)

```
salute=Good morning!
Farewell=Goodbye!
```

i18n_fr_FR.properties

```
salute=Bonjour!
farewell=Au revoir!
```

i18n_en_GB.properties

```
salute=Good morning!
farewell=Goodbye!
```

i18n_de_DE.properties

```
salute=Guten Tag!
Farewell=Auf Wiedersehen!
```

Resources

- Powerful access to low-level resources
- Avoids direct use of classloaders
- Simplifies exception handling
- Wrappers for regular Java classes
- Several built-in implementations:
  - ClassPathResource
  - FileSystemResource
  - URLResource

```
public interface Resource
    extends InputStreamSource
{
    boolean exists();
    boolean isOpen();
    URL getURL();
    File getFile();
    Resource createRelative( String p );
    String getFileName();
    String getDescription();
}

public interface InputStreamSource()
{
    InputStream getInputStream();
}
```

Summary

- IoC Container
  - BeanFactory, ApplicationContext
- Bean scopes
  - Singleton
  - Prototype
- Customization of bean lifecycle
  - Initialization
  - Destruction
- Internationalization
  - MessageSource
- Resources
  - Classpath, Filesystem, URL

Resources

- Lots of books on Spring:
  - Rod Johnson, Juergen Hoeller: *Expert One-on-One J2EE Development without EJB*
  - Justin Gehtland, Bruce A. Tate: *Better, Faster, Lighter Java*
  - Craig Walls and Ryan Breidenbach: *Spring in Action*
- The Spring reference documentation
  - www.springframework.org