



Spring Workshop

Quick Start / Intro

https://github.com/Michaeli71/ADC_BOOTCAMP_SPRING

Michael Inden

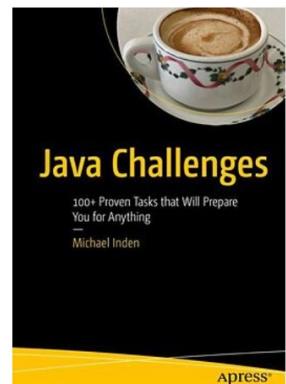
Speaker Intro



- **Michael Inden, Year of Birth 1971**
- **Diploma Computer Science, C.v.O. Uni Oldenburg**
- **~8 ¼ Years SSE at Heidelberger Druckmaschinen AG in Kiel**
- **~6 ¾ Years TPL, SA at IVU Traffic Technologies AG in Aachen**
- **~4 ¼ Years LSA / Trainer at Zühlke Engineering AG in Zurich**
- **~3 Years TL / CTO bei Direct Mail Informatics / ASMIQ in Zurich**
- **Independent Consultant, Conference Speaker and Trainer**
- **Since January 2022 Head of Development at Adcubum in Zurich**
- **Author @ dpunkt.verlag and APress**

E-Mail: michael.inden@hotmail.com

Blog: <https://jaxenter.de/author/minden>





Agenda

Workshop Contents



- **PART 1: Introduction**
 - History of Spring
 - Spring Architecture
- **PART 2: Dependency Injection**
 - Basics of IoC / DI
 - Spring Beans
 - Configuration
 - Types of Dependency Injection
 - Dependency Resolution Strategies

Workshop Contents



- **PART 3: Bean Initialization / Scopes + Lifecycle**
 - Bean Initialization & Laziness
 - Circular Dependencies
 - Bean Scopes
 - Bean Lifecycle Callbacks
- **PART 4: Spring MVC**



PART 1: Introduction

Father of Spring



Rod Johnson

@springrod

CEO, Atomist. Creator of Spring,
Cofounder/CEO at SpringSource,
Investor, Author

◎ Sydney / Bay Area

🔗 atomist.com

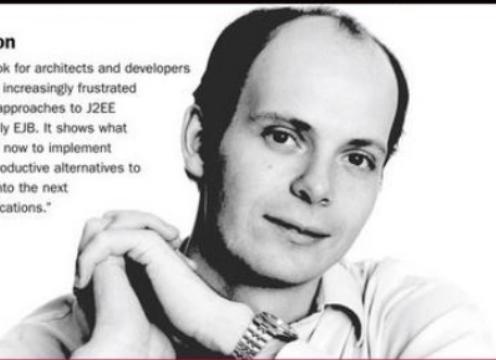
Spring's Origin



Programmer to Programmer™

Rod Johnson

"I wrote this book for architects and developers who have grown increasingly frustrated with traditional approaches to J2EE design, especially EJB. It shows what you can do right now to implement cleaner, more productive alternatives to EJB and move into the next era of web applications."



expert one-on-one™
**J2EE™ Development
without EJB™**

Rod Johnson with Juergen Hoeller

wrox

Updates, source code, and Wrox technical support at www.wrox.com

Rod Johnson

"I wrote this book for architects and developers who have grown increasingly frustrated with traditional approaches to J2EE design, especially EJB. It shows what you can do right now to implement cleaner, more productive alternatives to EJB and move into the next era of web applications."



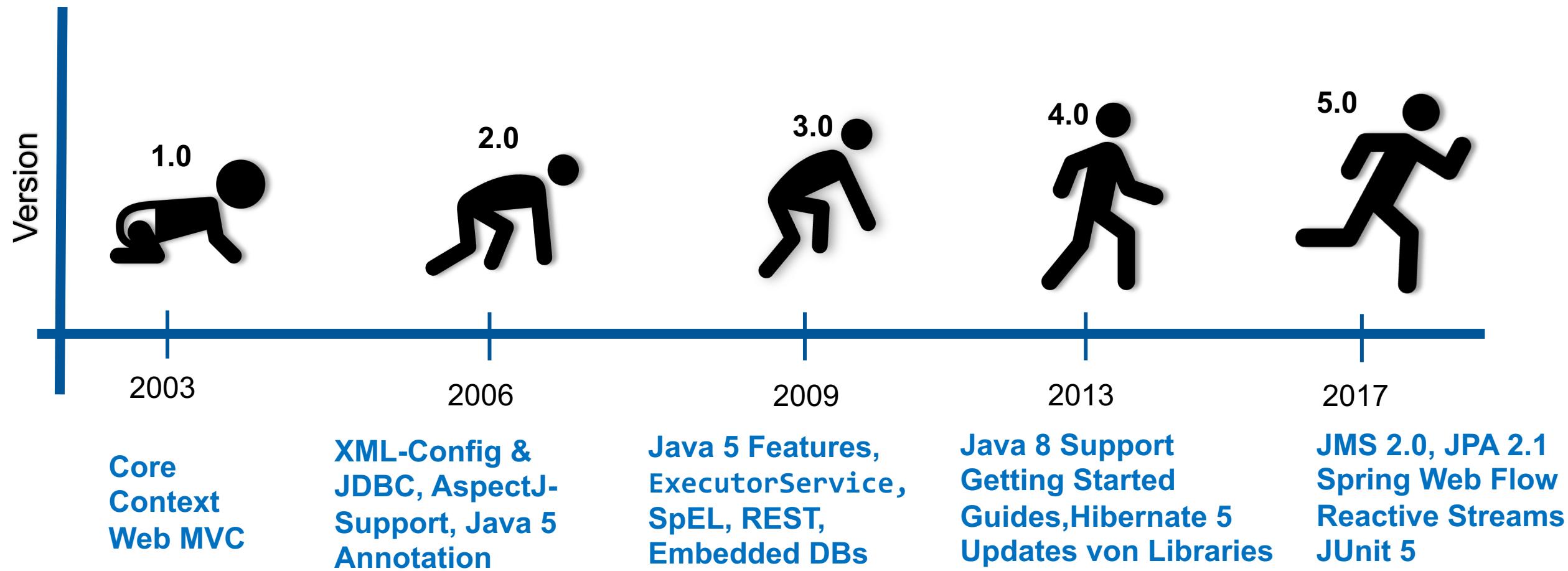
Professional **Java™ Development with the Spring Framework**

Rod Johnson, Juergen Hoeller, Alef Verdonck, Thomas Risberg, Colin Sampson

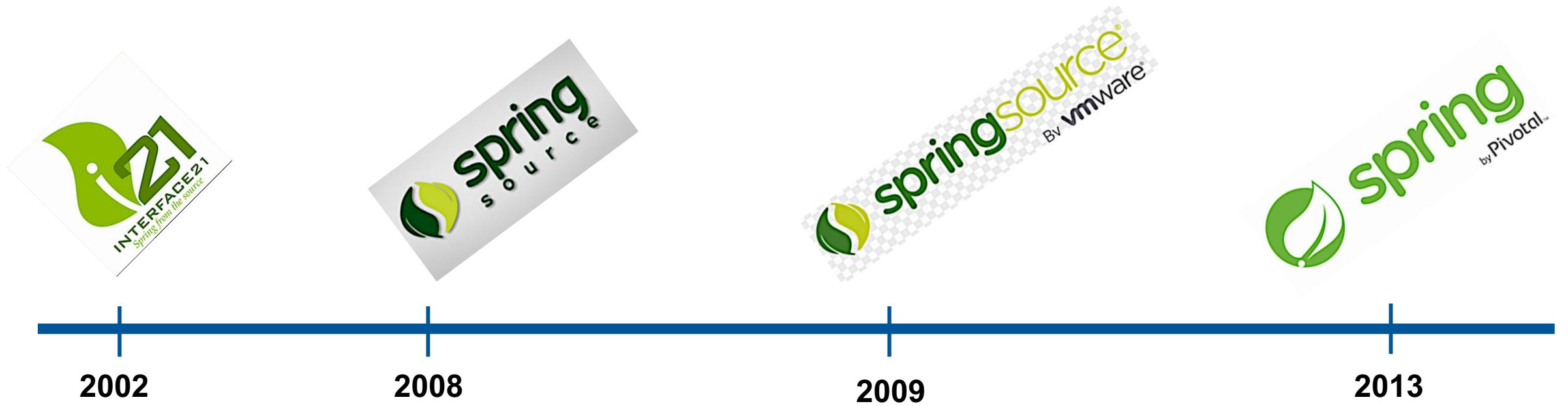


Updates, source code, and Wrox technical support at www.wrox.com

Spring's Emergence



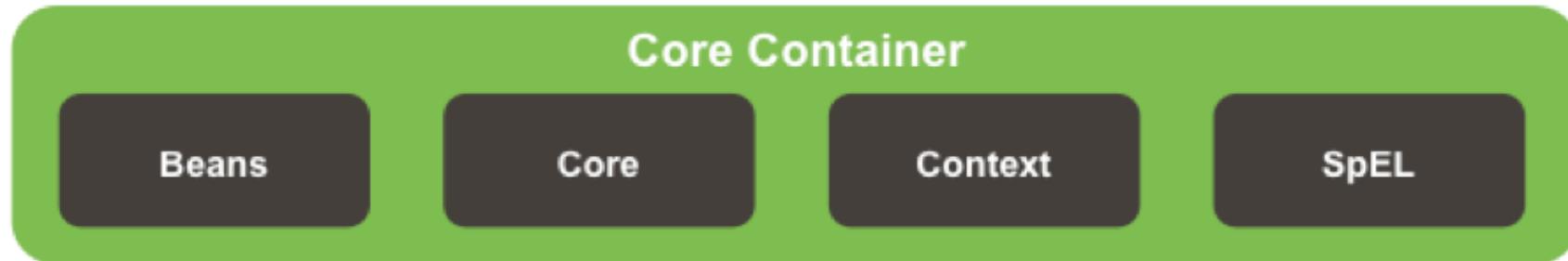
History of the company





Advantages of Spring

- **Lightweight**
 - Just POJO – need not implement/extend any framework interfaces/classes
- **Modular**
 - Include just the needed module to use the needed functionality.
 - For DI just include spring-context

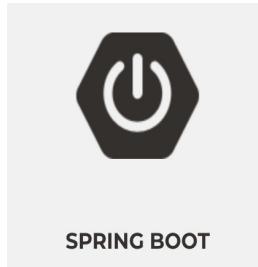


- **Non-intrusive**
 - domain logic code generally has no dependencies on the framework itself

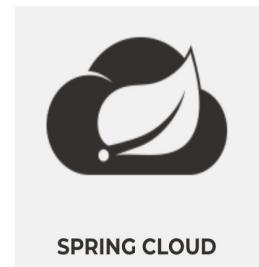
Major Spring Projects



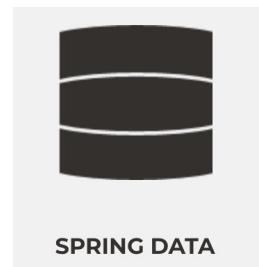
SPRING FRAMEWORK



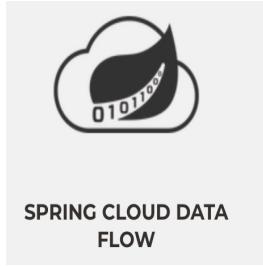
SPRING BOOT



SPRING CLOUD



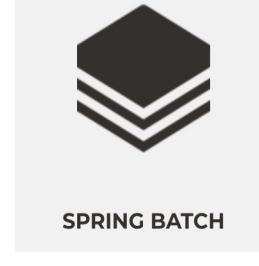
SPRING DATA



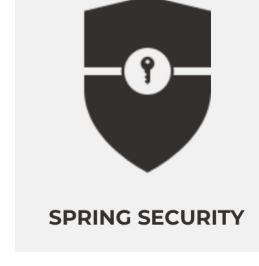
SPRING CLOUD DATA
FLOW



SPRING INTEGRATION



SPRING BATCH



SPRING SECURITY

Spring Framework - JDK Baseline



Version	JDK 6	JDK 7	JDK 8	JDK 9	JDK 10	JDK 11	JDK 12
4.3.x	👍	👍	👍	👎	👎	👎	👎
5.0.x	👎	👎	👍	👍	👍	👎	👎
5.1.x	👎	👎	👍	👍	👍	👍	👍

Spring Framework – Version Overview



Branch	Initial Release	End of Support	End Commercial Support *
5.3.x	2020-10-27	2024-12-31	2026-12-31
5.2.x	2019-09-30	2021-12-31	2023-12-31
5.1.x	2018-09-21	2020-12-31	2022-12-31

2019 2020 2021 2022 2023 2024 2025 2026 2027

5.3.x
5.2.x
5.1.x

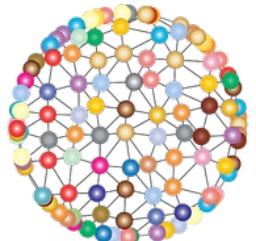
2022-09-17

OSS support
Free security updates and bugfixes with support from the Spring community. See [VMware Tanzu OSS support policy](#).

Commercial support
Business support from Spring experts during the OSS timeline, plus extended support after OSS End-Of-Life.
Publicly available releases for critical bugfixes and security issues when requested by customers.



**Is Spring working with
the Java module system?**





Yes, Spring Framework 5 ships with **automatic module name entries** in the manifests of our Spring Framework 5 jars. The public API surface of the Spring libraries remains unchanged.



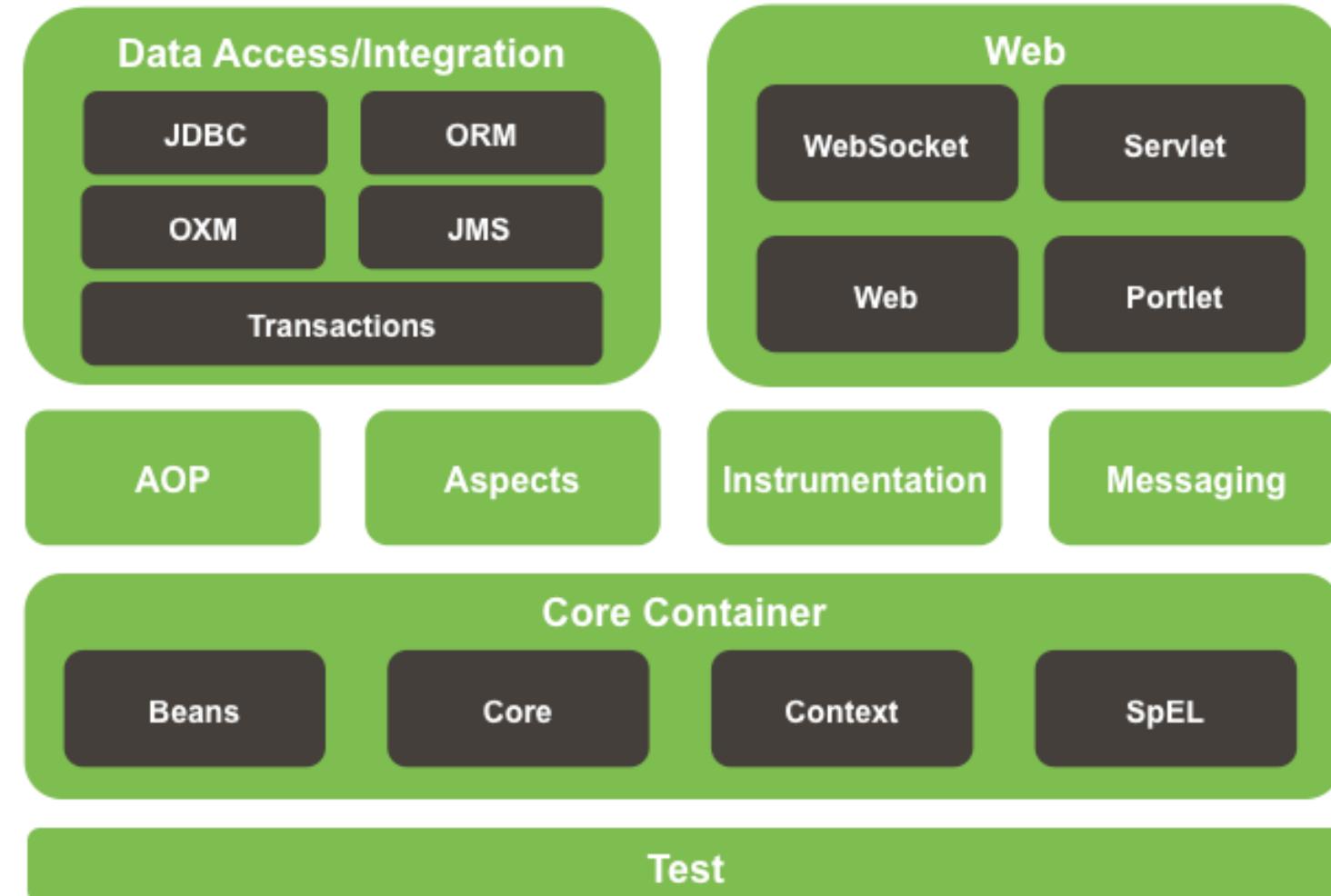
Spring Architecture



Spring Architecture



Spring Framework Runtime





Core Container

Beans

Core

Context

SpEL

▼ spring-core-5.1.5.RELEASE.jar -

▼ org.springframework

► asm

► cglib

► core

► lang

► objenesis

► util



Inversion of Control



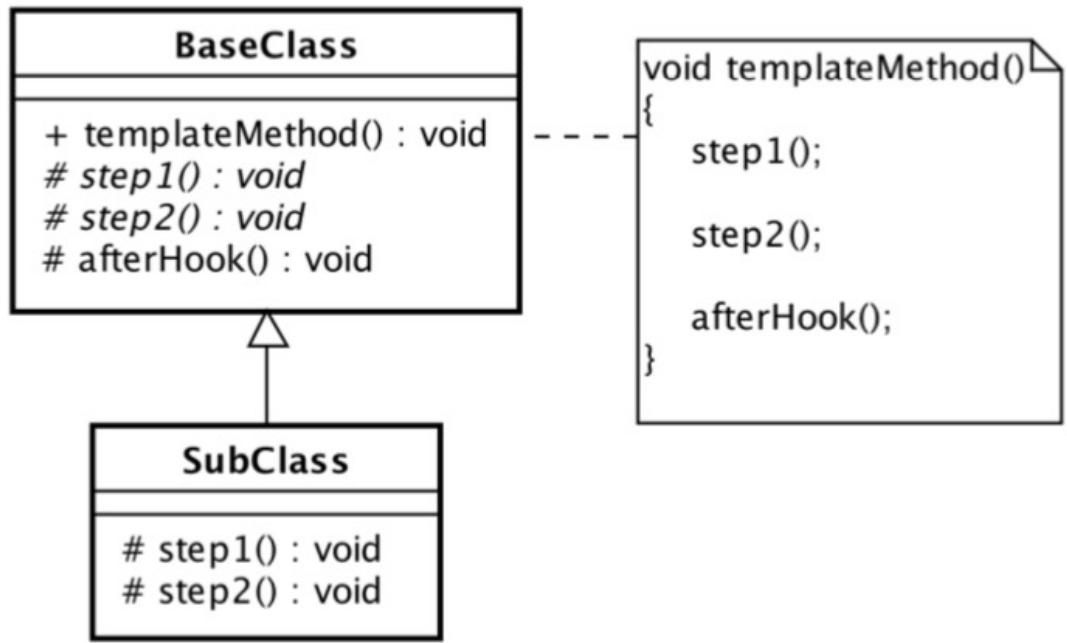


Inversion of Control

- Hollywood Principle («Don't call us, we'll call you»)



Inversion of Control: Template Method Pattern



```
public void paint(Graphics g)
{
    super.paint(g);

    final Graphics2D g2d = (Graphics2D) g;

    drawSheetAndBackground(g2d);

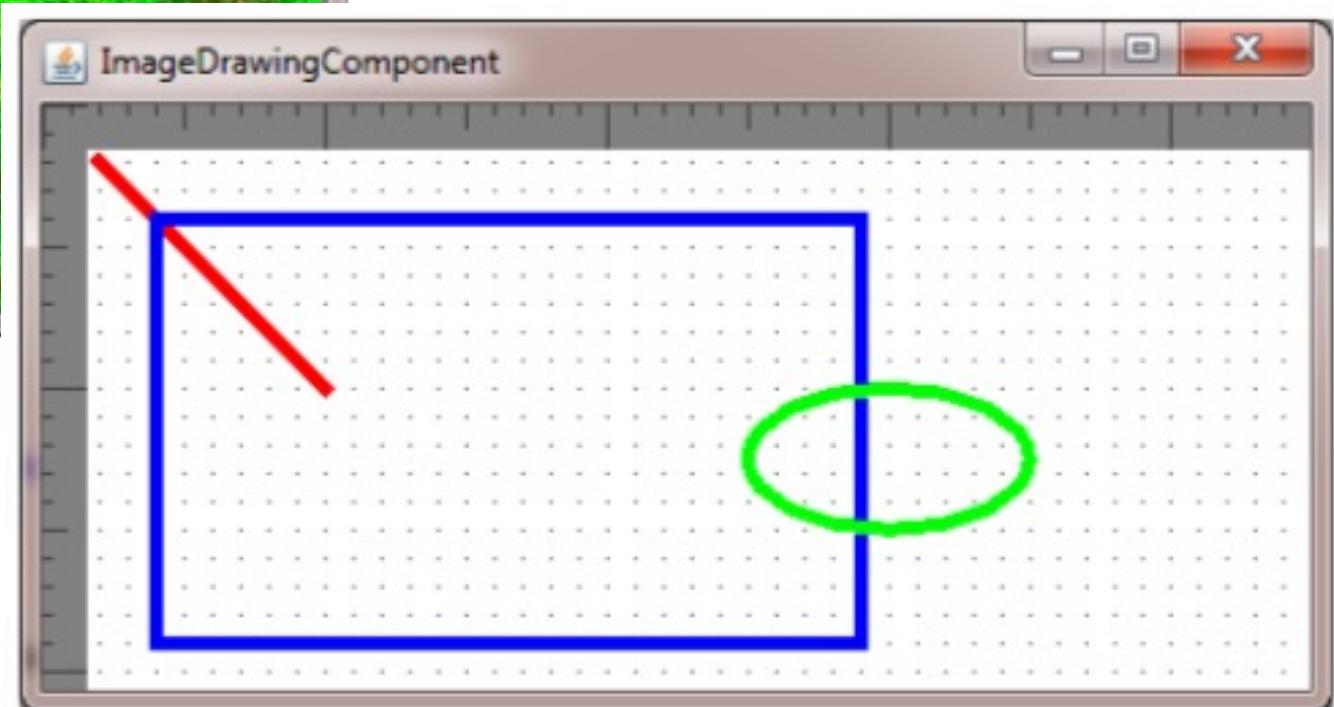
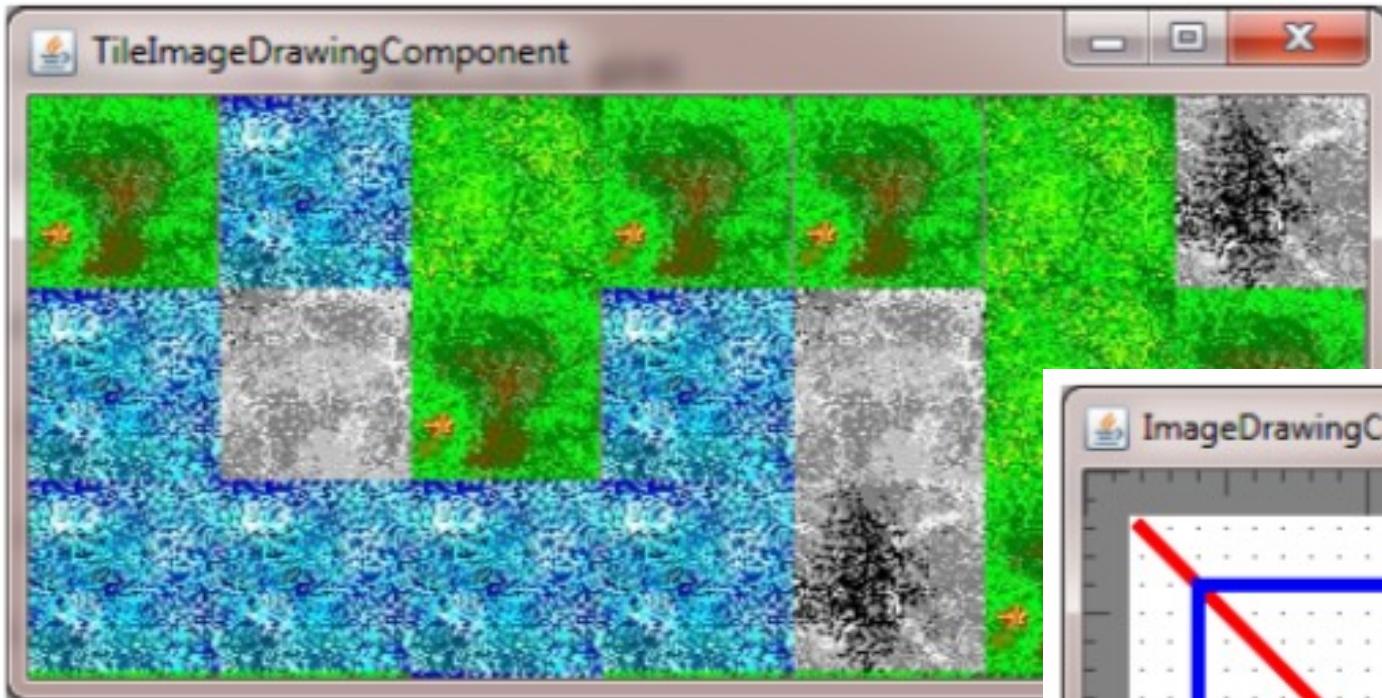
    if (showRuler)
        drawRuler(g2d);

    if (showGrid)
        drawGrid(g2d);

    drawContent(g2d);
}

public abstract drawContent(Graphics2D g2d);
```

Example



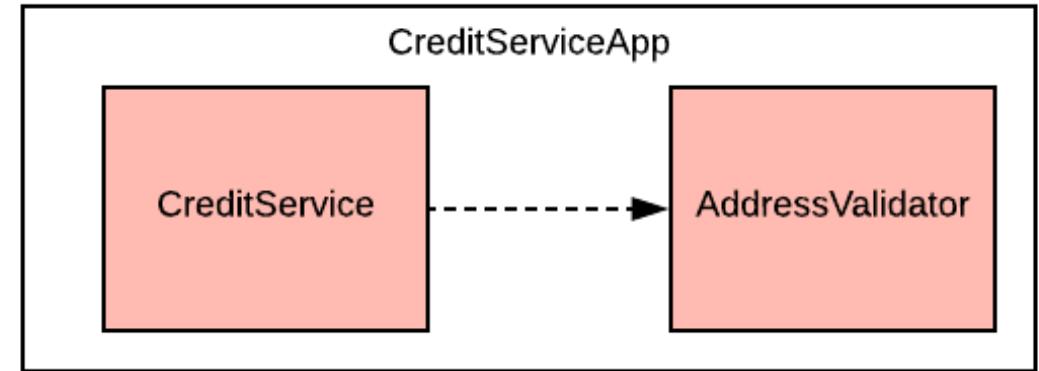
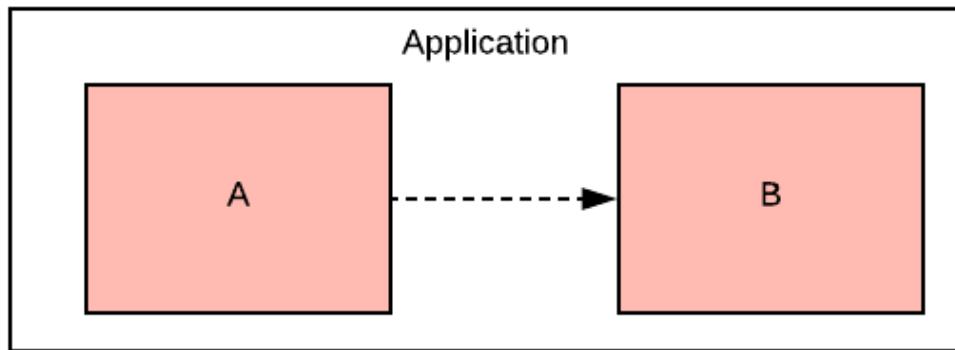


PART 2: Dependency Injection



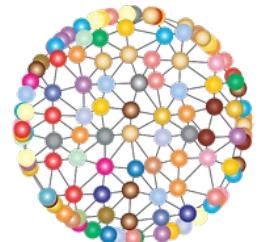
Dependencies – Short Recap

- Dependency \Leftrightarrow one class uses another





**Central question: How do
I get to the dependency?**



**In the past often:
By calling new.**



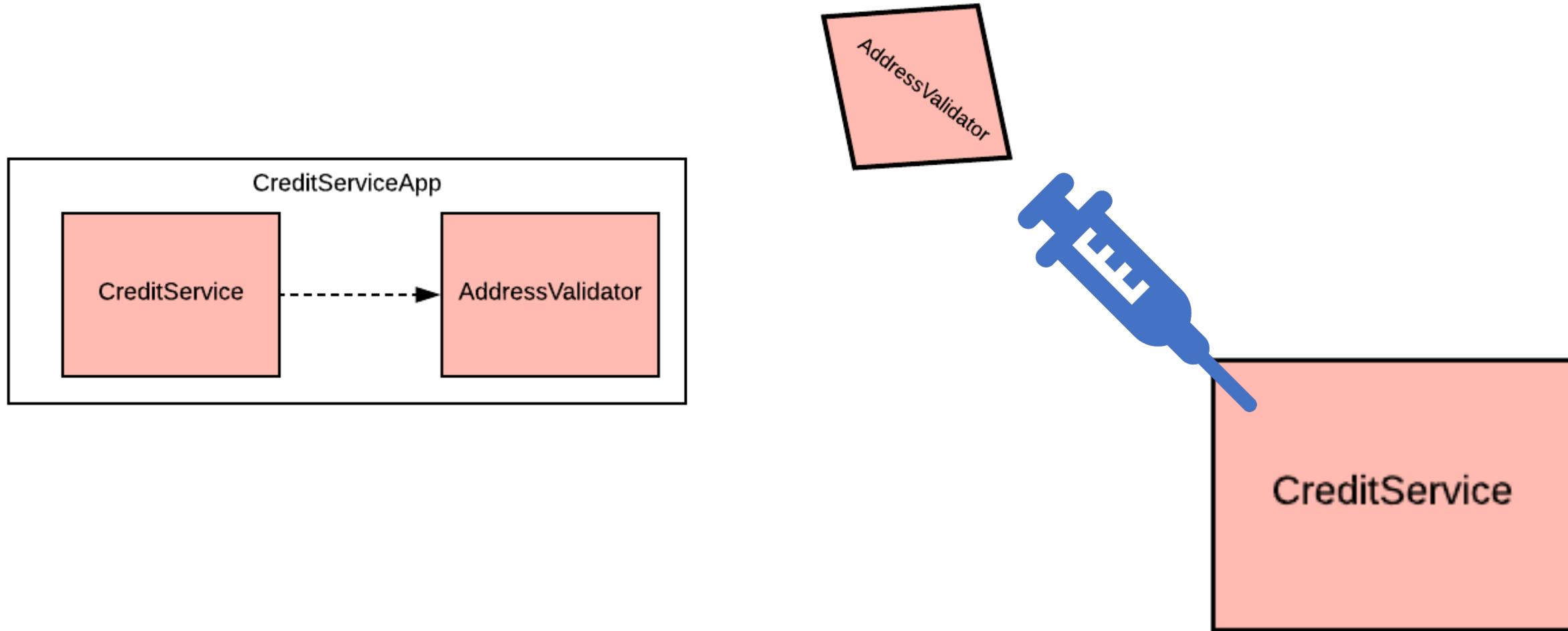
Dependency Injection

The process of introducing the **dependency** to the **dependent object** is called dependency injection





Dependency Injection in Action



Dependency Injection



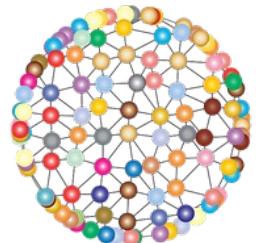
```
public class CreditServiceApp {  
  
    public static void main(String[] args) {  
        var addressValidator = new AddressValidator();  
        var creditService = new CreditService(addressValidator);  
        creditService.dispatchCredit();  
    }  
  
}
```

Manuelle Dependency Injection



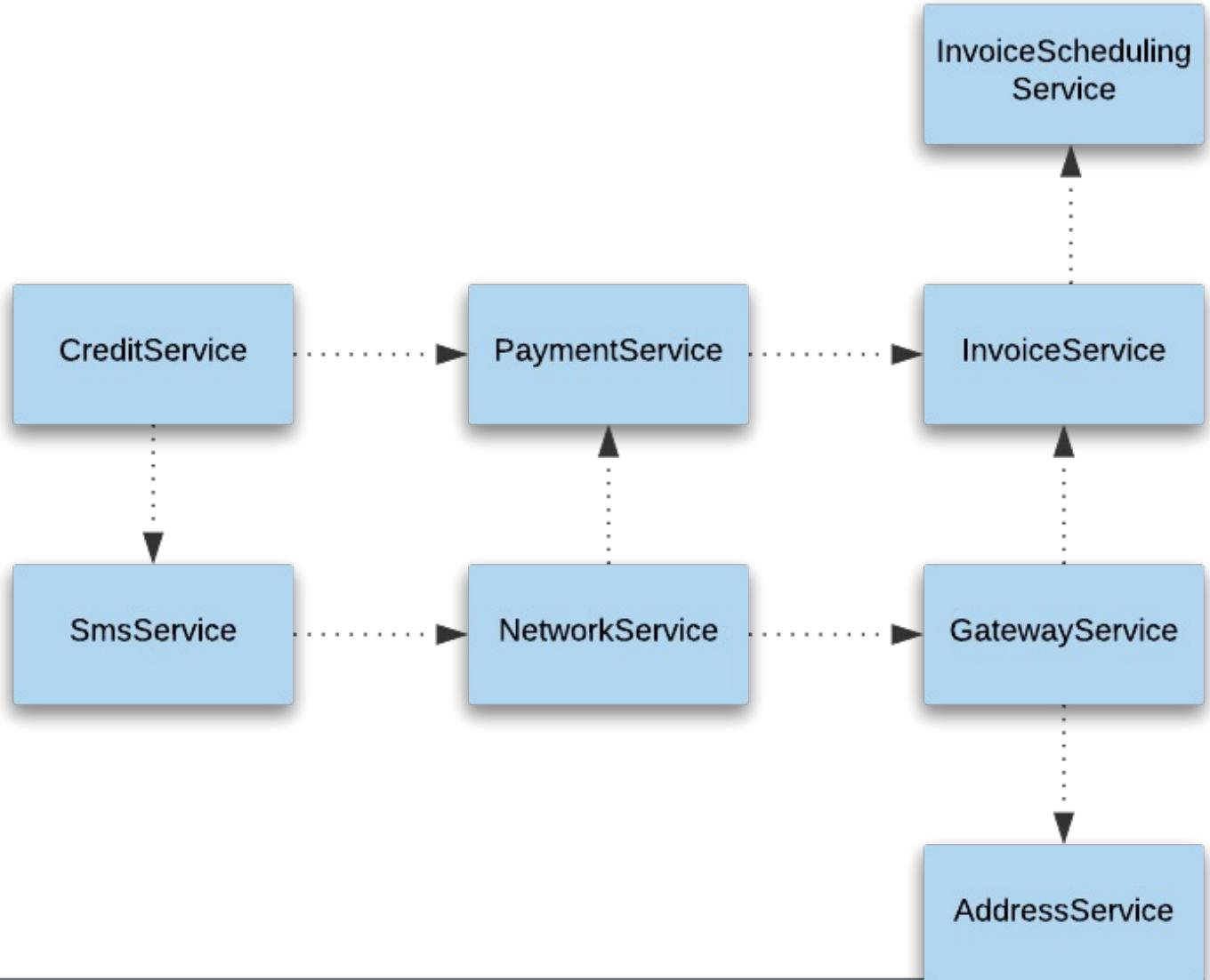
```
public class CreditServiceApp {  
    public static void main(String[] args) {  
        var addressValidator = new AddressValidator();  
        var creditService = new CreditService(addressValidator);  
        creditService.dispatchCredit();  
    }  
}
```

Manual DI
A blue hand icon pointing upwards.



**What is a main problem
with calling new?**

What about such an object graph?





Problems of manual DI

- Complex
 - Many manual object constructions & boilerplate code
 - Tight coupling
 - Poor readability
 - Sometimes internal construction is visible to the outside
 - Sometimes difficult to test (object constructions, flows, ...)
-



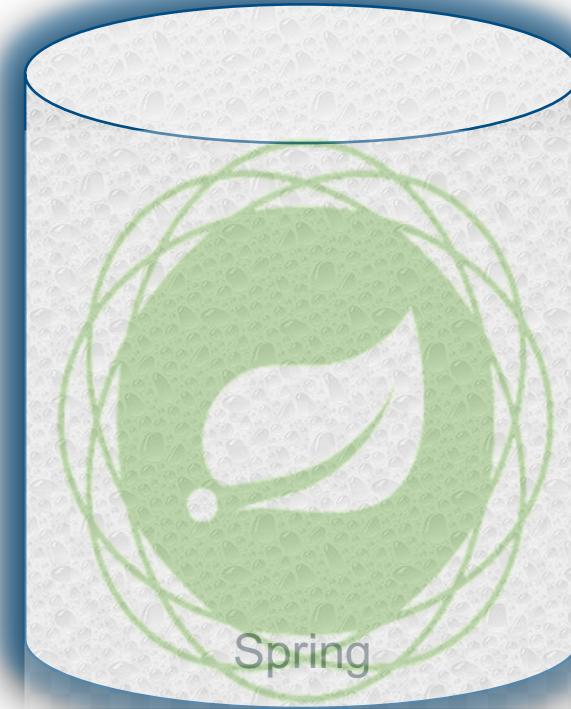
Dependency Injection in Spring



IoC Container



- Is also (only) an object
- Manages other objects
- Enables Dependency Injection
- Builds the object graph

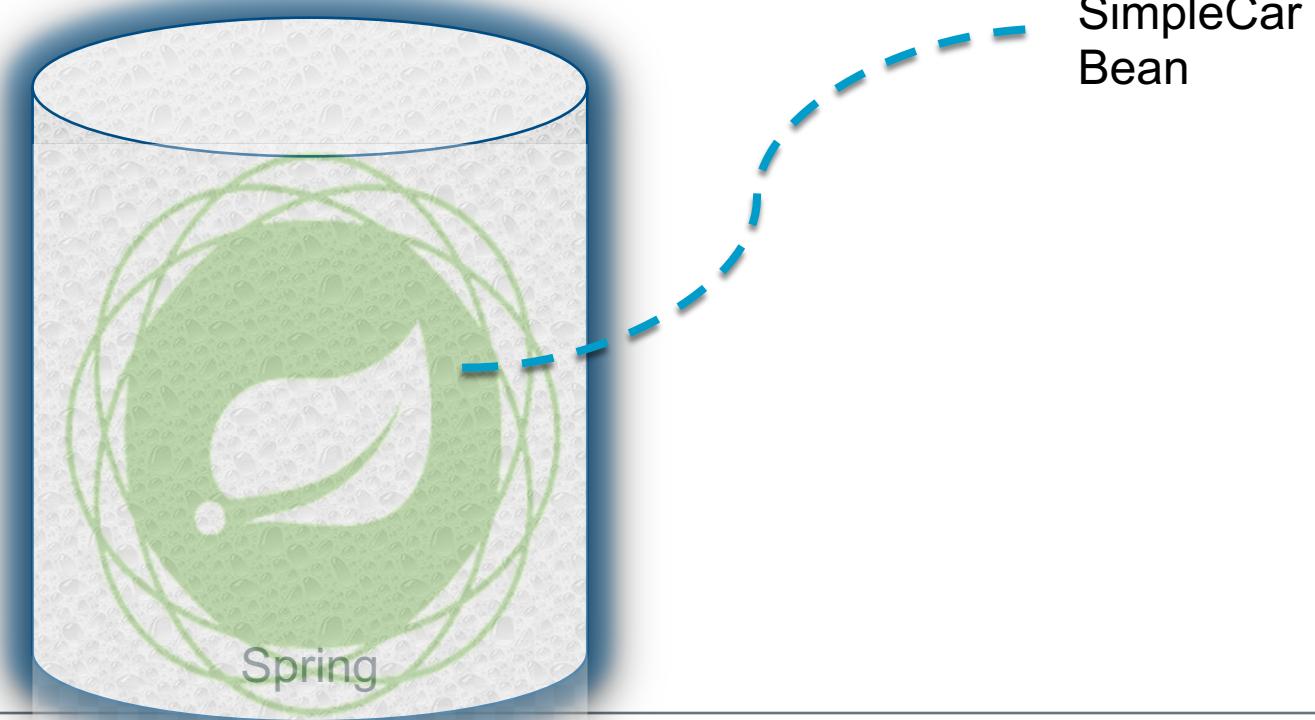




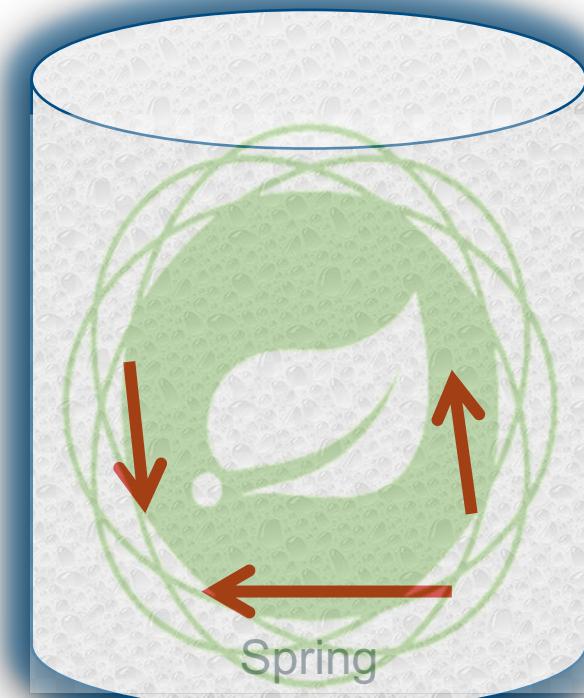
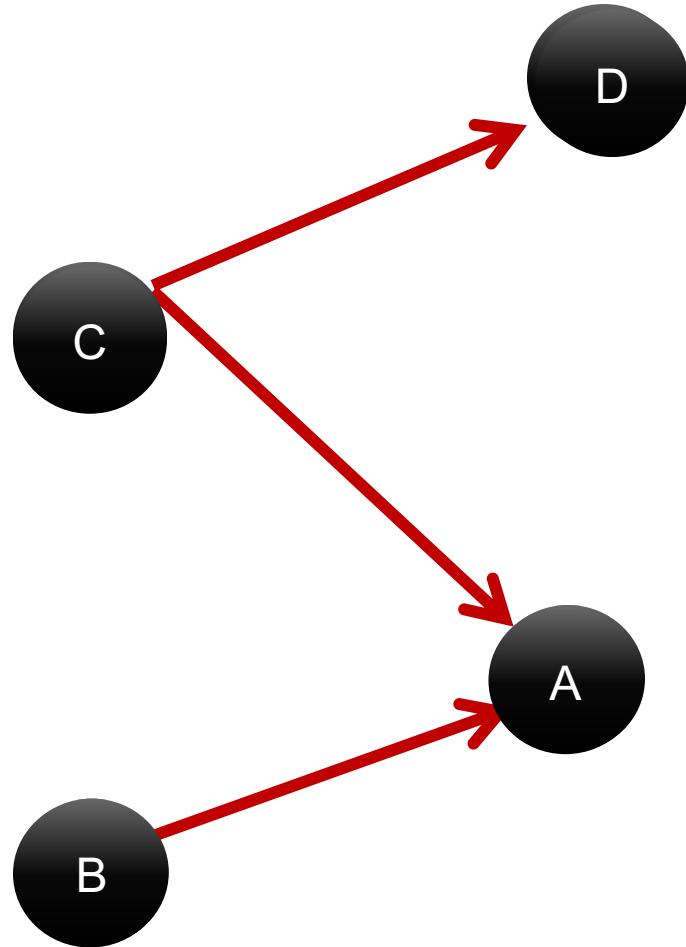
Spring Beans

- Plain Old Java Object (POJO) which is/will be **managed** by the Spring is called [Spring Bean](#).

SimpleCar

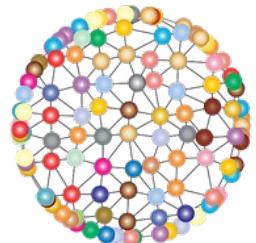


IoC Container – Topological sorting and object creation





**How does the IoC
container know how the
beans need to be
configured and are
related?**





Configuration





Configuration Metadata

The information needed to configure the IoC Container is **Configuration Metadata**



XML



ANNOTATION



JAVA



XML Configuration



```
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
       xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
       xsi:schemaLocation="http://www.springframework.org/schema/beans
http://www.springframework.org/schema/beans/spring-beans.xsd">

    <bean id="person" class="ch.karthi.Person">
        <property name="name" value="karthi" />
        <property name="age" value="22" />
    </bean>

</beans>
```



@Configuration

```
public class MyConfig{
```

@Bean

```
    public Person createPerson(){
        Person person = new Person();
        person.setName("karthi");
        person.setAge("22");
        return person;
    }
```

```
}
```



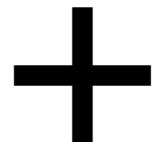
Annotation Configuration



```
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
       xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
       xmlns:c="http://www.springframework.org/schema/c"
       xmlns:context="http://www.springframework.org/schema/context"
       xsi:schemaLocation="http://www.springframework.org/schema/beans
                           http://www.springframework.org/schema/beans/spring-beans.xsd
                           http://www.springframework.org/schema/context
                           http://www.springframework.org/schema/context/spring-context.xsd">

    <context:component-scan base-package="ch.javaprofi_academy" />

</beans>
```

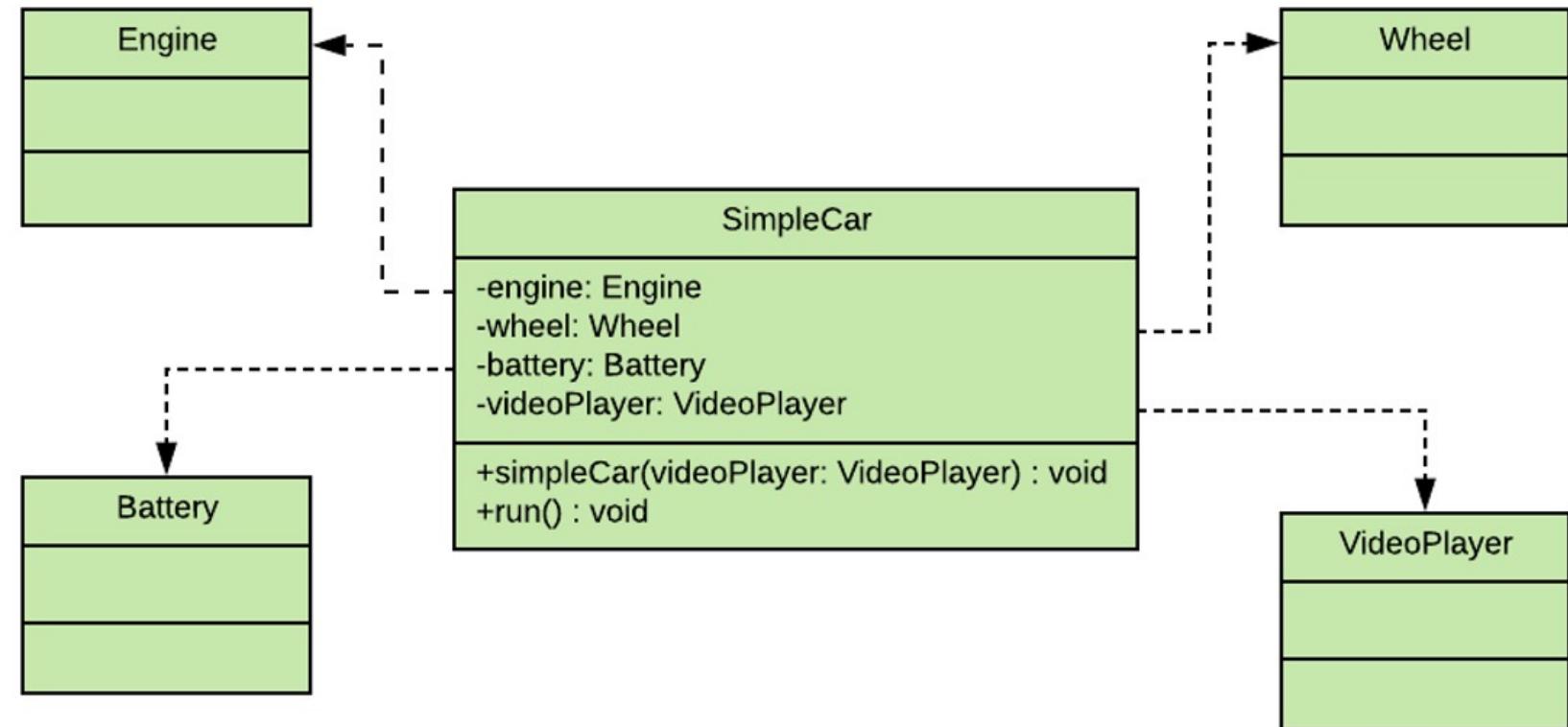
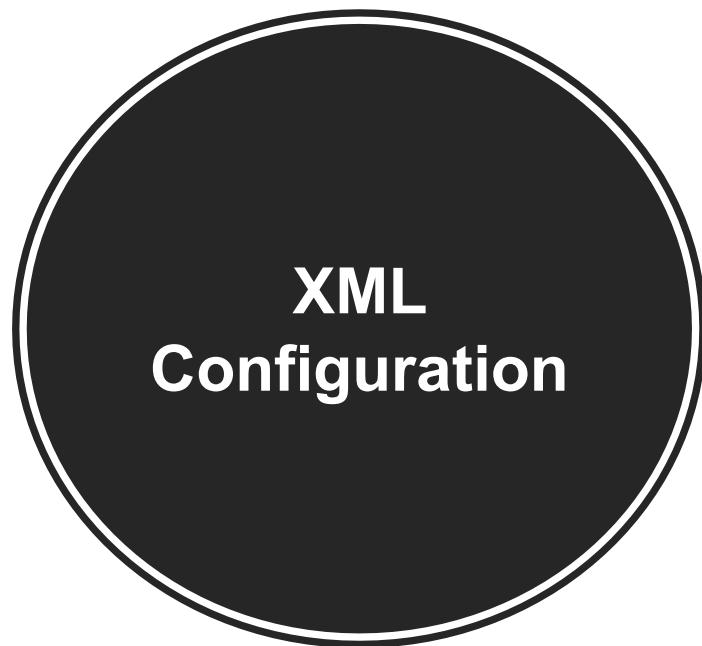


```
@Component
public class Person {
```

...

}

Example for XML-Konfiguration



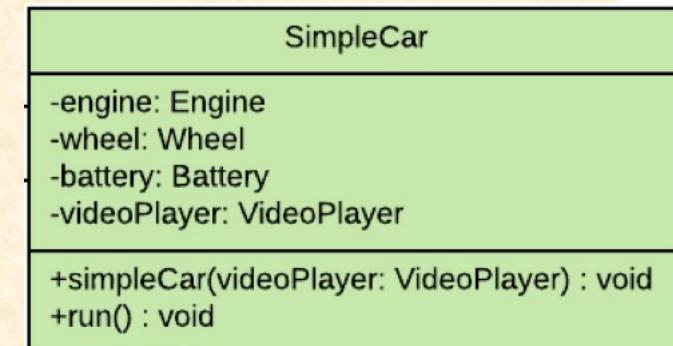
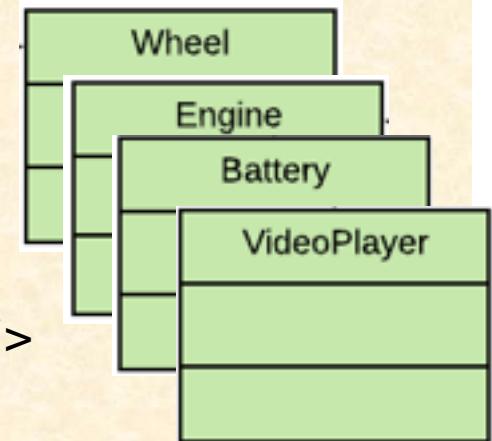


```
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
       xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
       xsi:schemaLocation="http://www.springframework.org/schema/beans
                           http://www.springframework.org/schema/beans/spring-beans.xsd">
```

```
    <bean id="wheel" class="ch.karthi.Wheel"/>
    <bean id="engine" class="ch.karthi.Engine"/>
    <bean id="battery" class="ch.karthi.Battery"/>
    <bean id="videoPlayer" class="ch.karthi.VideoPlayer"/>
```

```
    <bean id="simpleCar" class="ch.karthi.SimpleCar">
        <constructor-arg ref="videoPlayer" name="videoPlayer"/>
        <property name="engine" ref="engine" />
        <property name="wheel" ref="wheel"/>
        <property name="battery" ref="battery"/>
    </bean>
```

```
</beans>
```





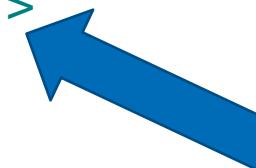
XML Configuration Special feature with construction



```
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
       xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
       xmlns:c="http://www.springframework.org/schema/c"
       xsi:schemaLocation="http://www.springframework.org/schema/beans
                           http://www.springframework.org/schema/beans/spring-beans.xsd">

    <bean name="customer1" class="ch.javaprofi_academy.Customer">
        <constructor-arg name="name" value="Michael" />
        <constructor-arg name="address" value="Zürich" />
    </bean>

    <bean name="customer2" class="ch.javaprofi_academy.Customer"
          c:name="Tim" c:address="Kiel" />
    ...
</beans>
```





XML Configuration Special feature with construction

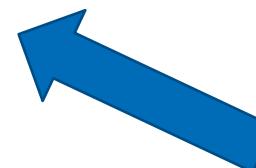


```
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
       xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
       xmlns:c="http://www.springframework.org/schema/c"
       xsi:schemaLocation="http://www.springframework.org/schema/beans
                           http://www.springframework.org/schema/beans/spring-beans.xsd">

    ...
    <bean id="emailService" class="ch.asmiq.EmailService" />
    <bean id="smsService" class="ch.asmiq.SmsService" />

    <bean id="academyService" class="ch.asmiq.AcademyService"
          c:emailService-ref="emailService">
        <constructor-arg name="smsService" ref="smsService" />
    </bean>

</beans>
```



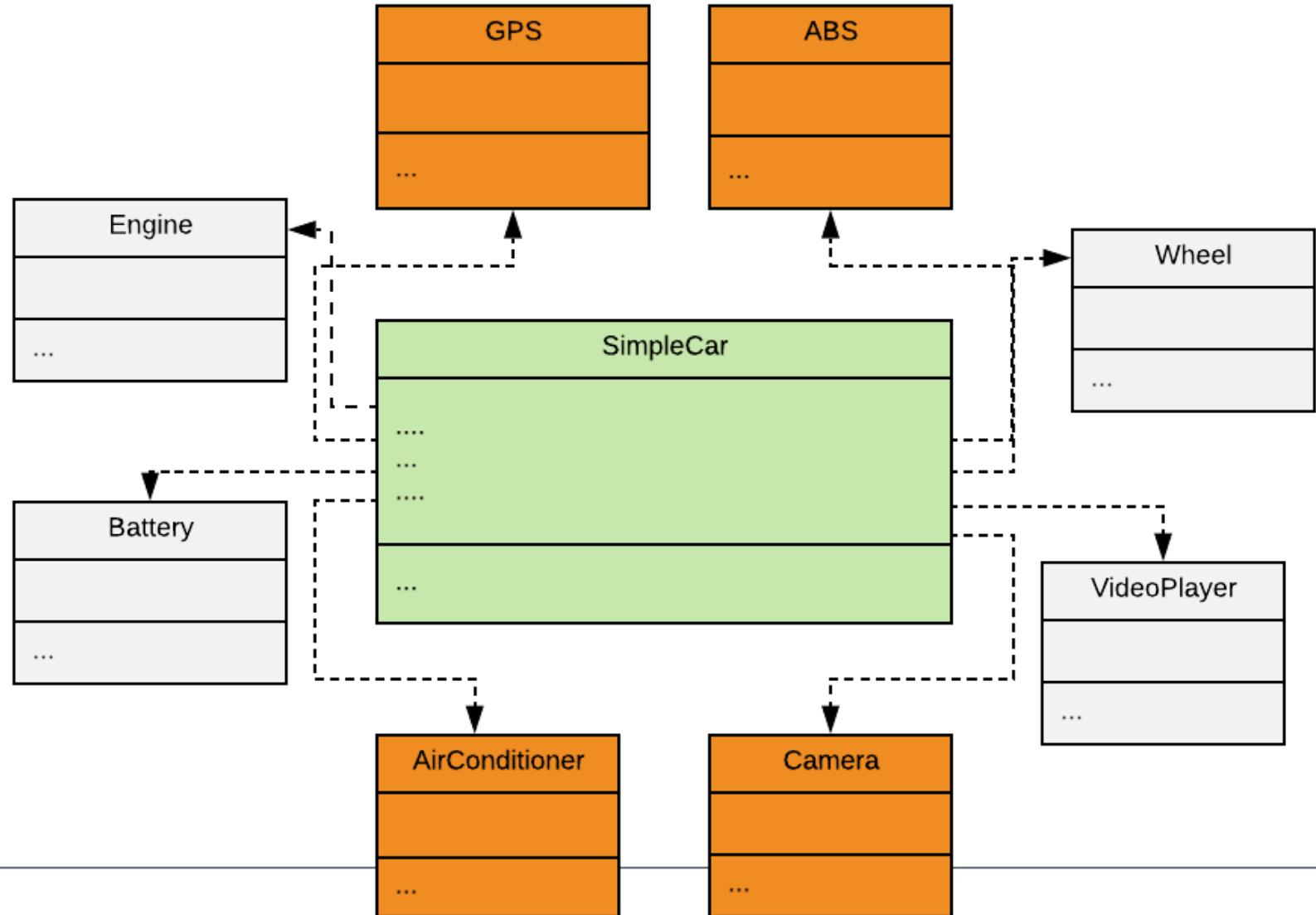


Demo

SimpleXmlConfigApp
ServiceXmlConfigApp



XML Configuration



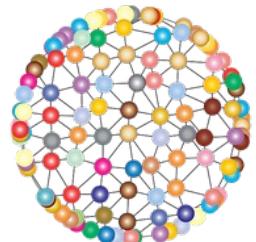


```
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
       xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
       xsi:schemaLocation="http://www.springframework.org/schema/beans
                           http://www.springframework.org/schema/beans/spring-beans.xsd">

    <bean id="wheel" class="ch.karthi.Wheel"/>
    <bean id="engine" class="ch.karthi.Engine"/>
    <bean id="battery" class="ch.karthi.Battery"/>
    <bean id="videoPlayer" class="ch.karthi.VideoPlayer"/>
    <bean id="gps" class="ch.karthi.GPS"/>
    <bean id="camera" class="ch.karthi.Camera"/>
    <bean id= ... />
    ...
    <bean id="simpleCar" class="ch.karthi.SimpleCar">
        <constructor-arg ref="videoPlayer" name="videoPlayer"/>
        <property name="engine" ref="engine" />
        <property name="wheel" ref="wheel"/>
        <property name="battery" ref="battery"/>
        <property ....>
    </bean>
</beans>
```



**Wouldn't it be nice if
Spring could take some of
the work off our hands?**





```
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
       xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
       xmlns:context="http://www.springframework.org/schema/context"
       xsi:schemaLocation="http://www.springframework.org/schema/beans
                           http://www.springframework.org/schema/beans/spring-beans.xsd
                           http://www.springframework.org/schema/context
                           http://www.springframework.org/schema/context/spring-context.xsd">
```

```
    <context:component-scan base-package="ch.karthi" />
```

```
        <bean id="simpleCar" class="ch.karthi.SimpleCar">
            <constructor-arg ref="videoPlayer" name="videoPlayer"/>
            <property name="engine" ref="engine" />
            <property name="wheel" ref="wheel"/>
            <property name="battery" ref="battery"/>
            <property ....>
        </bean>
```

```
</beans>
```

```
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
       xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
       xmlns:context="http://www.springframework.org/schema/context"
       xsi:schemaLocation="http://www.springframework.org/schema/beans
                           http://www.springframework.org/schema/beans/spring-beans.xsd
                           http://www.springframework.org/schema/context
                           http://www.springframework.org/schema/context/spring-context.xsd">
```



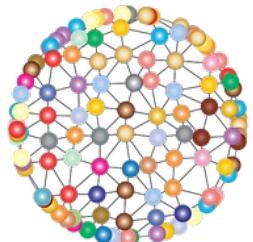
```
<context:component-scan base-package="ch.karthi" />

<bean id="simpleCar" class="ch.karthi.SimpleCar">
    <constructor-arg ref="videoPlayer" name="videoPlayer"/>
    <property name="engine" ref="engine" />
    <property name="wheel" ref="wheel"/>
    <property name="battery" ref="battery"/>
    <property .....
</bean>

</beans>
```



**Can you please make
it a little easier?**





Stereotype Annotations

```
@Component  
public class Engine {
```

```
@Component  
public class VideoPlayer {
```



```
@Component  
public class Wheel {
```

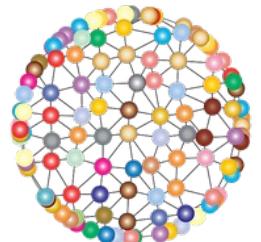
```
@Component  
public class SimpleCar {
```

```
@Component  
public class Battery {
```

Stereotype Annotations



- **@Component**
 - **@Service**
 - **@Repository**
 - **@Controller**
 - **@RestController**
 - **@Configuration**
-



**How it is possible to
define the dependencies
in Java?**



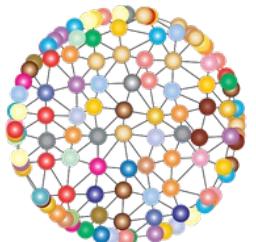
@Autowired

```
@Component
public class SimpleCar {
    @Autowired
    private Engine engine;
    @Autowired
    private Wheel wheel;
    @Autowired
    private Battery battery;

    // this is autowired through constructor
    private VideoPlayer videoPlayer;
    ...
    @Autowired
    public SimpleCar(VideoPlayer videoPlayer) {
        this.videoPlayer = videoPlayer;
    }
}
```



**Can we do without
XML entirely?**



Java Configuration + @ComponentScan



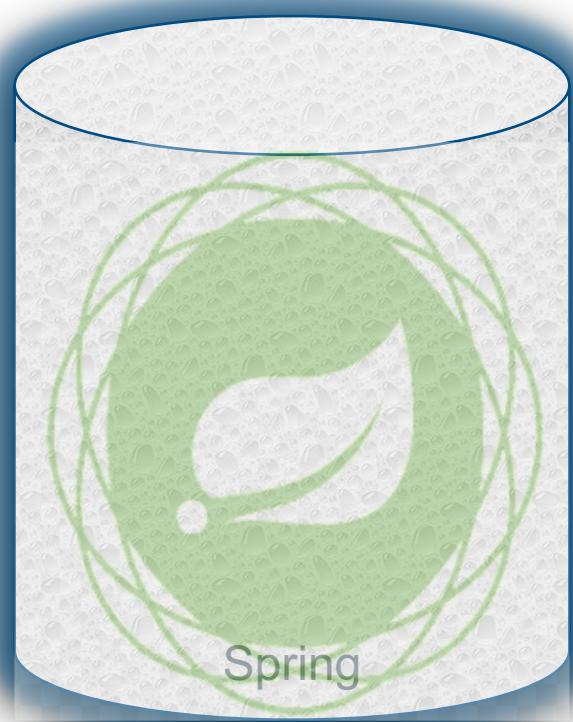
```
@ComponentScan("ch.karthi")
public class AppConfig {...}
```

```
@Component
public class Engine {...}
```

```
<bean id="engine" class="ch.karthi.Engine"></bean>
...
<bean id="simpleCar" class="ch.karthi.SimpleCar">
    <constructor-arg ref="videoPlayer"
name="videoPlayer"></constructor-arg>
    <property name="engine" ref="engine"></property>
    ...
</bean>
```

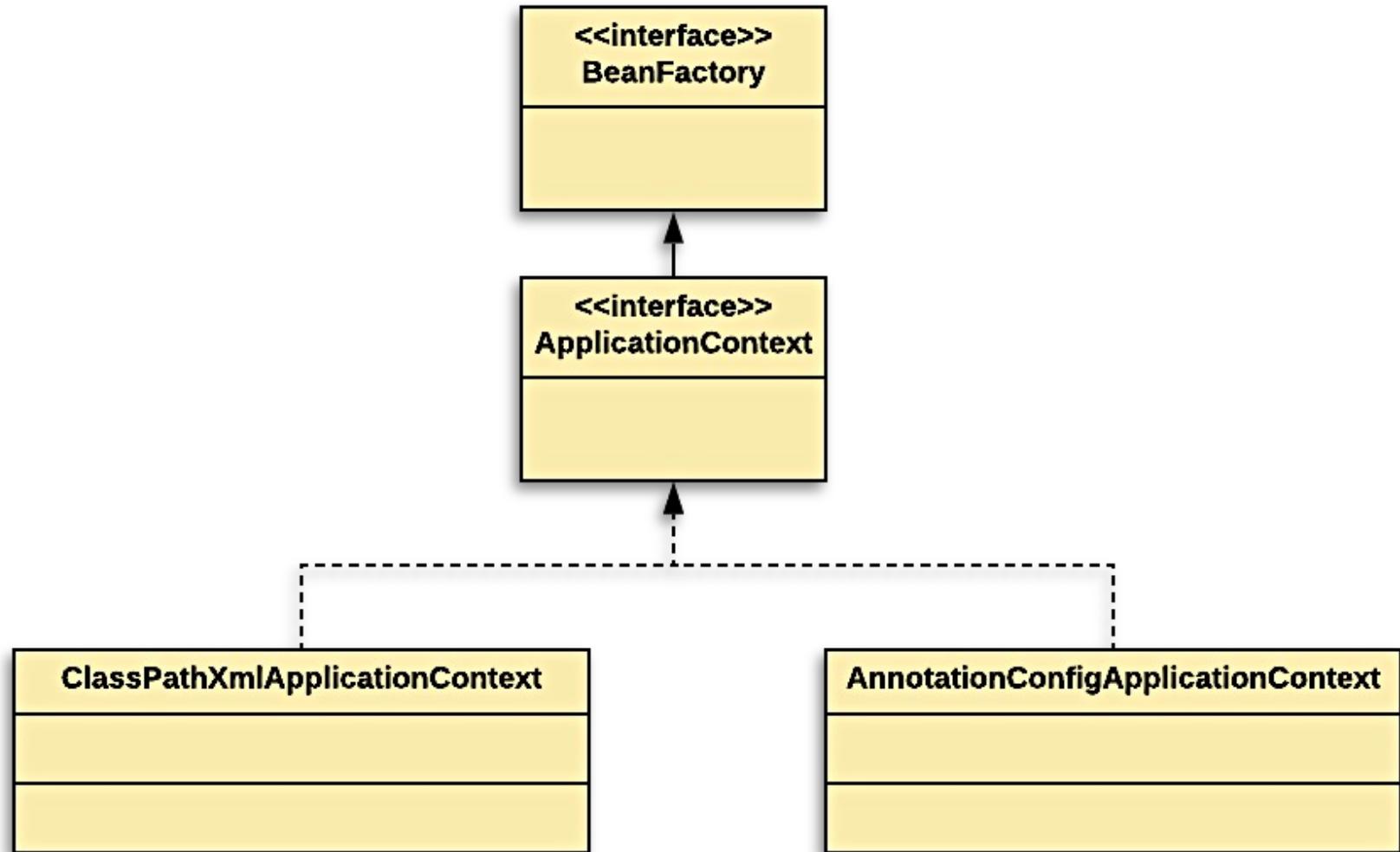
```
@Component
public class SimpleCar {
    @Autowired
    private Engine engine;
}
```

IoC Container instantiation & usage





IoC Container in Spring



XML



```
var container = new ClassPathXmlApplicationContext("config.xml");

var simpleCar = container.getBean(SimpleCar.class);

// start the simpleCar
```

```
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
       xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
       xsi:schemaLocation="http://www.springframework.org/schema/beans
                           http://www.springframework.org/schema/beans/spring-beans.xsd">

    <bean id="wheel" class="ch.karthi.Wheel"/>
    <bean id="engine" class="ch.karthi.Engine"/>
    <bean id="battery" class="ch.karthi.Battery"/>
    <bean id="videoPlayer" class="ch.Karthi.VideoPlayer"/>
    <bean id="gps" class="ch.karthi.GPS"/>
    <bean id="camera" class="ch.karthi.Camera"/>
    <bean id= ... />
    ...

```

Annotation



```
var container = new ClassPathXmlApplicationContext("config.xml");

var simpleCar = container.getBean(SimpleCar.class);

// start the simpleCar
```

```
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
       xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
       xmlns:context="http://www.springframework.org/schema/context"
       xsi:schemaLocation="http://www.springframework.org/schema/beans
                           http://www.springframework.org/schema/beans/spring-beans.xsd
                           http://www.springframework.org/schema/context
                           http://www.springframework.org/schema/context/spring-context.xsd">

    <context:component-scan base-package="ch.karthi" />

</beans>
```

Java



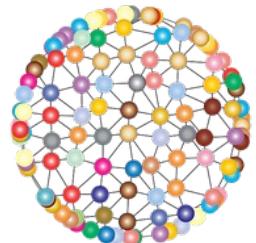
```
@ComponentScan("ch.karthi")
public class AppConfig {...}
```

```
var container = new AnnotationConfigApplicationContext(AppConfig.class);

var simpleCar = container.getBean(SimpleCar.class);

// start the simpleCar
```

```
@Configuration
public class AppConfig
{...}
```



**Is it possible to combine
multiple configurations?**

Java



```
@Configuration  
public class CustomerConfig {  
    @Bean  
    public Customer newMikeCustomer() {  
        return new Customer("Michael", "Zürich");  
    }  
  
    @Bean  
    public Customer newTimCustomer() {  
        return new Customer("Tim", "Kiel");  
    }  
}  
  
@Configuration  
public class ServiceConfig {  
    @Bean  
    public ServiceBean serviceBean() {  
        return new ServiceBean();  
    }  
}
```

Java



```
@Configuration  
@Import({CustomerConfig.class, ServiceConfig.class})  
public class ImportBeansConfig {  
    @Bean  
    public ExampleBean exampleBean() {  
        return new ExampleBean();  
    }  
}  
  
public static void main(String[] args) {  
    AnnotationConfigApplicationContext context =  
        new AnnotationConfigApplicationContext(ImportBeansConfig.class);  
  
    ExampleBean exampleBean = context.getBean(ExampleBean.class);  
    Customer customerBean = context.getBean("newMikeCustomer", Customer.class);  
  
    System.out.println(exampleBean);  
    System.out.println(customerBean);  
    context.close();  
}
```



Demo

MultipleAnnotationConfigDemo

Java



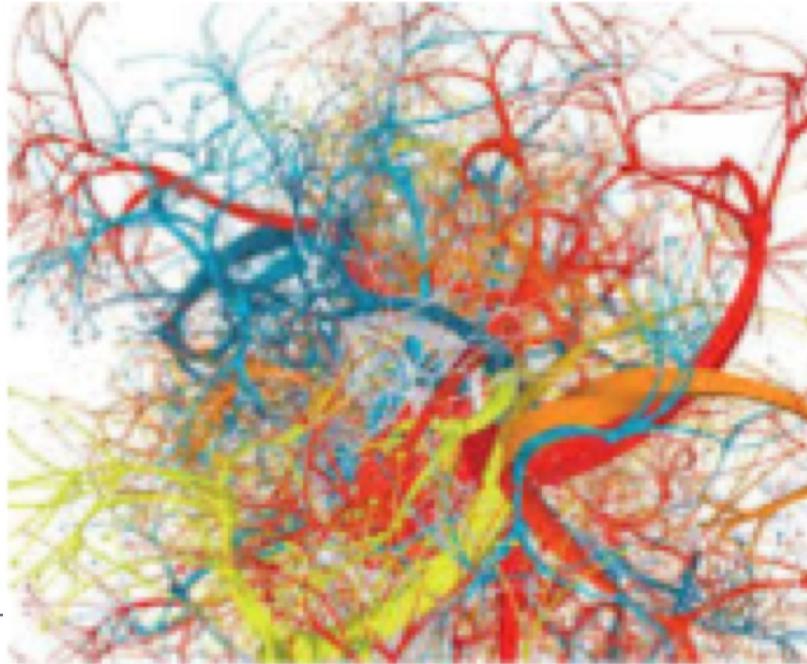
Spring Documentation

<https://docs.spring.io/spring-framework/docs/current/reference/html/core.html#beans-java-composing-configuration-classes>

<https://docs.spring.io/spring-javaconfig/docs/1.0.0.m3/reference/html/modularizing-configurations.html>



Types of Dependency Injection



Types of Dependency Injection



- Constructor-Injection
 - Setter / Method-Injection
 - Field-Injection
-



Constructor Injection

```
public SimpleCar(VideoPlayer videoPlayer){  
    this.videoPlayer = videoPlayer;  
}
```



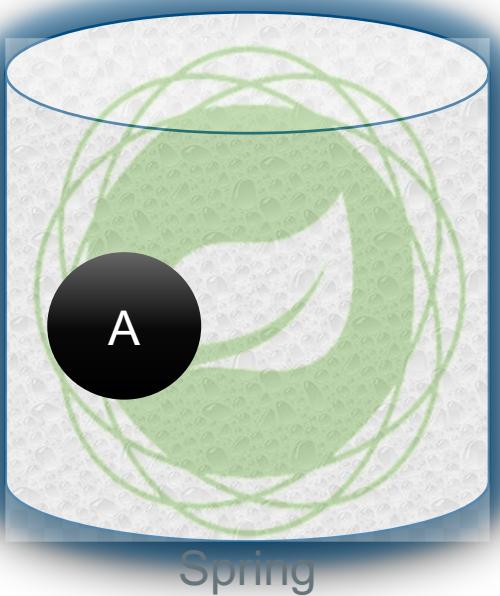
Constructor Injection

```
public SimpleCar() {}  
  
@Autowired  
public SimpleCar(VideoPlayer videoPlayer) {  
    this.videoPlayer = videoPlayer;  
}
```

Exception in thread "main"
java.lang.NullPointerException

Rule: @Autowired should be present at least on one constructor, when more than one constructor has been declared.

Constructor Injection Special Case



```
@Autowired  
public MyBean(A a) {
```



```
@Autowired  
public MyBean(A a, B b) {  
@Autowired  
public MyBean(A a,  
    @Autowired(required=false) B b) {
```



Caused by: org.springframework.beans.factory.NoSuchBeanDefinitionException: No qualifying bean of type 'ch.karthi.B' available: expected at least 1 bean which qualifies as autowire candidate. Dependency annotations: {}



Setter Injection

```
public class SimpleCar {  
  
    private Engine engine;  
  
    private Wheel wheel;  
  
    @Autowired  
    public void setEngine(Engine engine) {  
        this.engine = engine;  
    }  
  
    @Autowired  
    public void setWheel(Wheel wheel) {  
        this.wheel = wheel;  
    }  
}
```

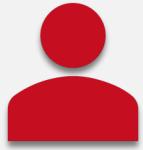


Field Injection

```
public class SimpleCar {  
    @Autowired  
    private Engine engine;  
  
    @Autowired  
    private Wheel wheel;  
}
```



Use constructor for
mandatory fields



Use setter for optional fields



Field injection should be
mostly avoided

Problems with Field Injection



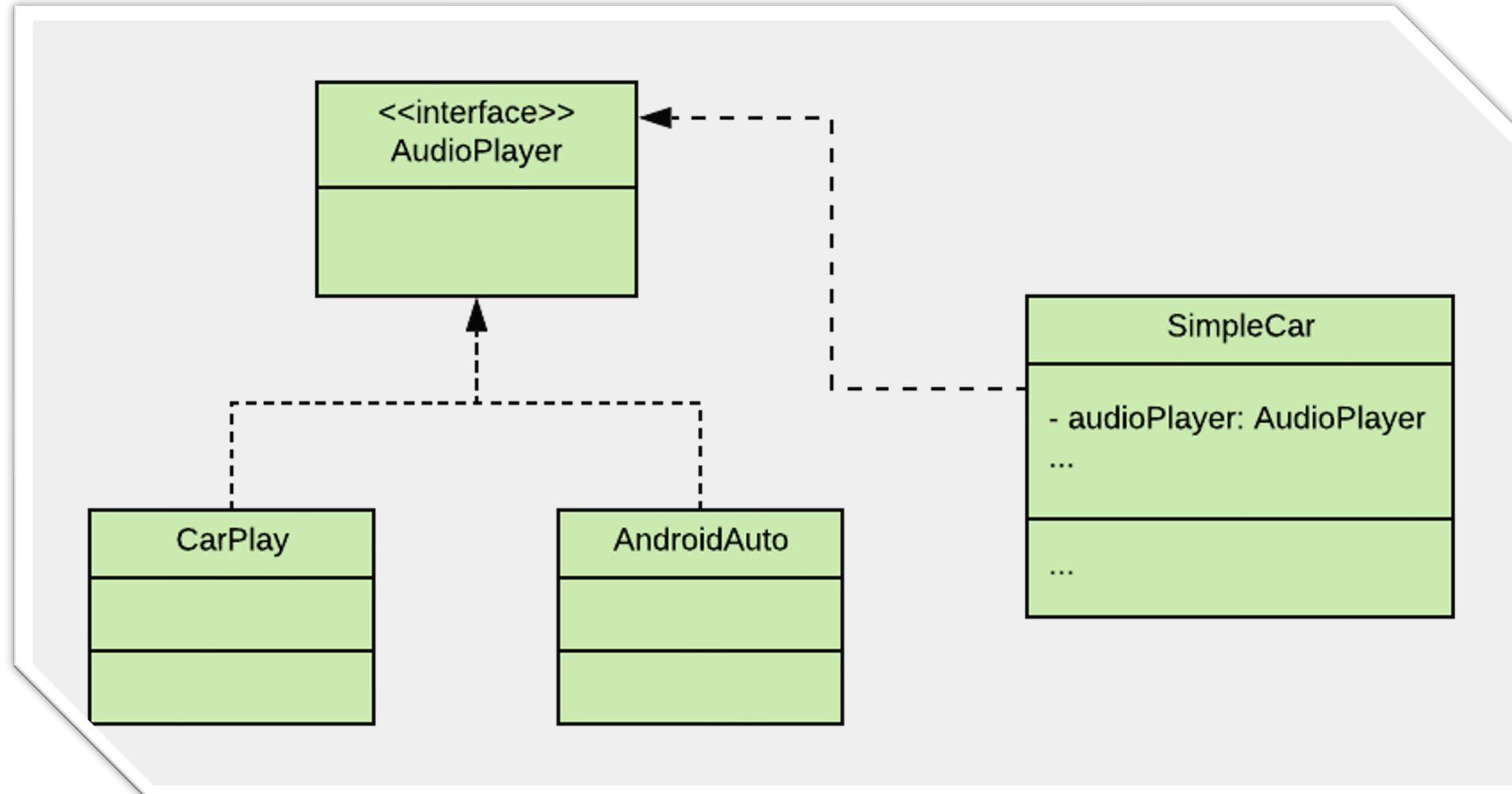
- Final/Immutable objects not possible.
 - Hard to ensure valid Object construction
 - Dependencies not clearly visible
 - Unit testing not possible w/o reflection
 - Heavily used field injection may be an indicator of violation of SRP.
-

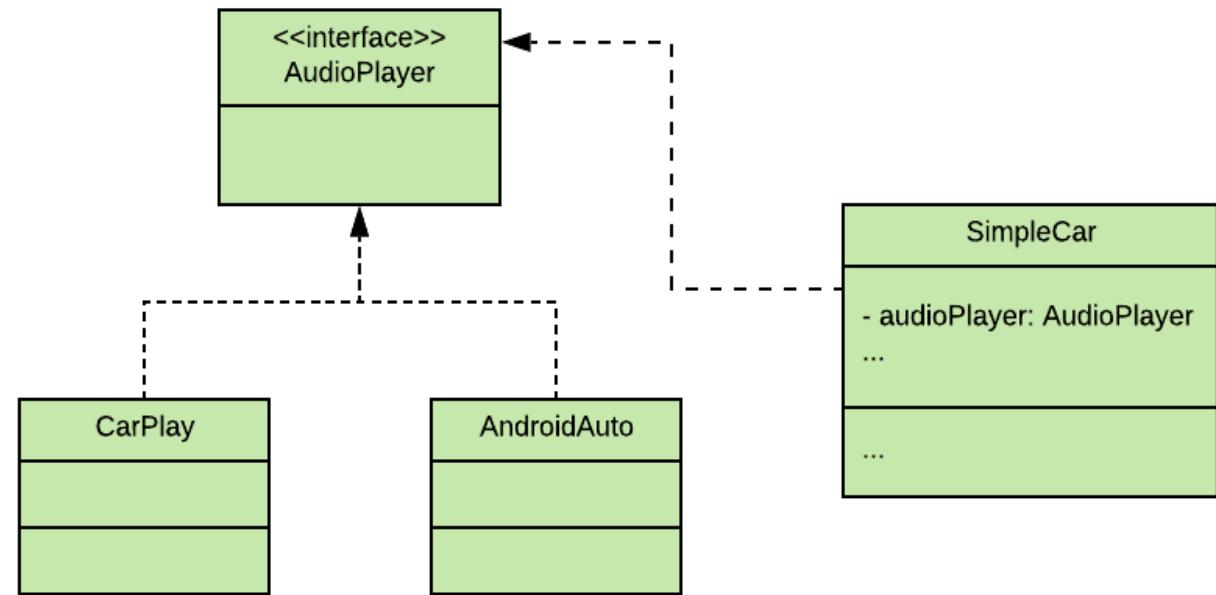


Dependency Resolution



SimpleCar with AudioPlayer





```
public interface AudioPlayer { ... }
```

@Component

```
public class AndroidAuto implements AudioPlayer { ... }
```

@Component

```
public class CarPlay implements AudioPlayer { ... }
```

@Component

```
public class SimpleCar {
```

@Autowired

```
private AudioPlayer audioPlayer;
```

```
}
```



org.springframework.beans.factory.NoUniqueBeanDefinitionException: No qualifying bean of type 'ch.karthi.AudioPlayer' available: expected single matching bean but found 2: androidAuto,carPlay



```
public interface AudioPlayer {...}
```

@Primary

```
@Component
```

```
public class AndroidAuto implements AudioPlayer { ... }
```

@Primary

```
@Component
```

```
public class CarPlay implements AudioPlayer { ... }
```

```
@Component
```

```
public class SimpleCar {
```

@Autowired

```
private AudioPlayer audioPlayer;
```

```
}
```



org.springframework.beans.factory.NoUniqueBeanDefinitionException: No qualifying bean of type 'ch.karthi.AudioPlayer' available: expected single matching bean but found 2: androidAuto,carPlay



@Qualifier

```
public interface AudioPlayer {...}
```

```
@Component("androidPlay")
public class AndroidAuto implements AudioPlayer { ... }
```

```
@Component("carPlay")
public class CarPlay implements AudioPlayer { ... }
```

```
@Component
public class SimpleCar {
```

```
    @Autowired
    @Qualifier("carPlay")
```

```
    private AudioPlayer audioPlayer;
```

```
}
```



`org.springframework.beans.factory.NoUniqueBeanDefinitionException: No qualifying bean of type 'ch.karthi.AudioPlayer' available: expected single matching bean but found 2: androidAuto,carPlay`

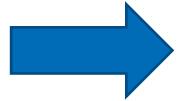
DI of scalar values



@Value



```
@Component  
public class Wheel {  
  
    private double radius = 2.34d;  
  
    ...  
  
}
```



```
@Component  
@PropertySource("car.properties")  
public class Wheel {  
  
    @Value("${wheel.radius}")  
    private double radius = -1.0d;  
  
    ...  
  
}
```

```
src/main/resources/car.properties  
wheel.radius=2.34
```

```
@Value("${wheel.radius:2.34}")  
private double radius = -1.0d;
```



Demo

DependencyConflictResolutionApp



PART 3:

Bean Initialization /

Scopes + Lifecycle

- Bean Initialization & Laziness
 - Circular Dependencies
 - Bean Scopes
 - Bean Lifecycle Callbacks
-



Bean Initialization



Bean Initialization



- No thoughts so far
 - always used the default
 - by default, beans are initialized DIRECTLY AT STARTUP
 - **helps to avoid dependency configuration errors**
-



Example class

```
@Component
public class SimpleCar {

    public void run() {
        //start battery
        //start engine
        //start the wheel
    }

    public void playMusic(){
        audioPlayer.playMusic();
    }

    @Autowired
    public void setAudioPlayer(AudioPlayer pl){
        this.audioPlayer = pl;
    }

    //setter injected battery,engine,
    //wheel & audioplayer
}
```



Usage in Application

```
@Component
public class AndroidAuto implements AudioPlayer {

    public AndroidAuto() {
        //check the internet connection (3 secs)
        //google account login (2 secs)
        //access for microphone and camera (4 secs)
        //load the playlists (2 secs)
        //cache the playlists (5 secs)
    }
}

var context = new AnnotationConfigApplicationContext(App.class);
SimpleCar simpleCar = context.getBean(SimpleCar.class);
simpleCar.run();

//later if user press the play button
simpleCar.playMusic();
```



Laziness is good 😊

Lazy Init as Remedy



```
@Component
public class SimpleCar {

    public void run() {
        //start battery
        //start engine
        //start the wheel
    }

    public void playMusic(){
        if (audioPlayer == null)
            audioPlayer = context.getBean(AudioPlayer.class);
        audioPlayer.playMusic();
    }

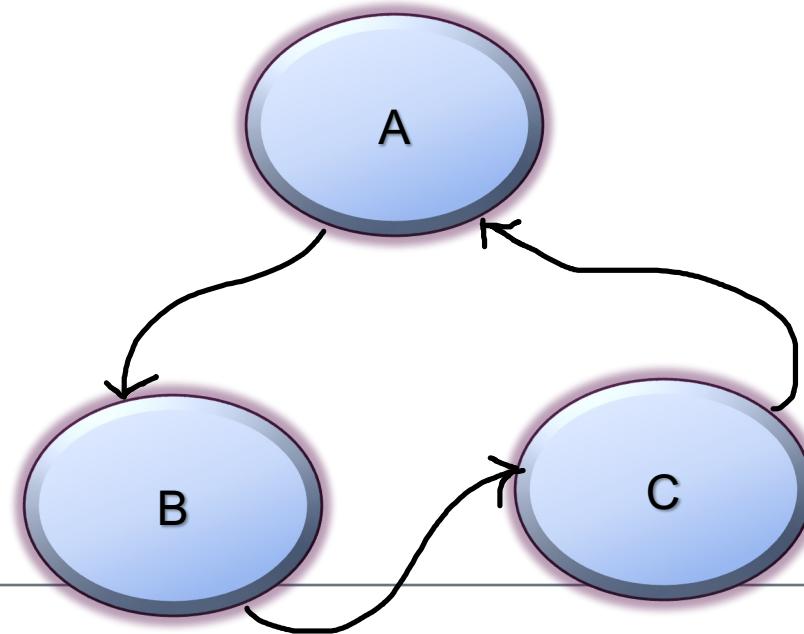
    //setter injected battery,engine,wheel
}
```

```
@Lazy
@Component
public class AndroidAuto implements AudioPlayer {

    public AndroidAuto() {
        //check the internet connection (3 secs)
        //google account login (2 secs)
        //access for microphone and camera (4 secs)
        //load the playlists (10 secs)
        //cache the playlists (5 secs)
    }
}
```



Circular Dependencies



Circular Dependency Example



```
@Component  
public class Student {  
  
    private Department department;  
  
    @Autowired  
    public Student(Department department) {  
        ...  
    }  
}
```

```
@Component  
public class Department {  
  
    private Student student;  
  
    @Autowired  
    public Department(Student student) {  
        ...  
    }  
}
```

Caused by: org.springframework.beans.factory.BeanCurrentlyInCreationException: Error creating bean with name 'department': Requested bean is currently in creation: Is there an unresolvable circular reference?



Circular dependencies solution

Modify some dependencies to be **injected through setters** => after construction

```
@Component
public class Student {

    private Department department;

    public Student(Department department) {
        ...
    }

    @Autowired
    public void setDepartment(Department dpt){
        this.department = dpt;
    }

}
```



Circular dependencies solution

Lazy initialize certain dependencies => Proxy gets created (*Interface as Indirection)

```
@Component  
public class Student {  
  
    private Department department;  
  
    public Student(@Lazy Department department) {  
        ...  
    }  
}
```

```
@Component  
public class Student {  
  
    private Department department;  
  
    private int age=36;  
  
    public Student(@Lazy Department department) {  
        this.department = department;  
    }  
  
    public int getAge() {  
        return age;  
    }  
}
```

department= Department\$\$EnhancerBySpringCGLIB\$\$f030f2cb (id=38)
 ↳ CGLIB\$BOUND= false
 ↳ CGLIB\$CALLBACK_0= CglibAopProxy\$DynamicAdvisedInterceptor (id=58)
 ↳ CGLIB\$CALLBACK_1= CglibAopProxy\$DynamicUnadvisedInterceptor (id=63)
 ↳ CGLIB\$CALLBACK_2= CglibAopProxy\$SerializableNoOp (id=65)



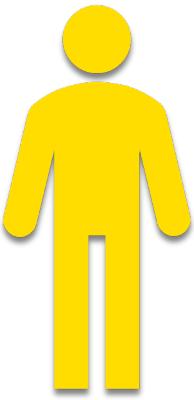
Bean Scopes



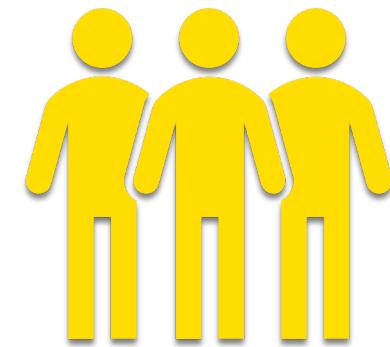


Bean Scopes

Default



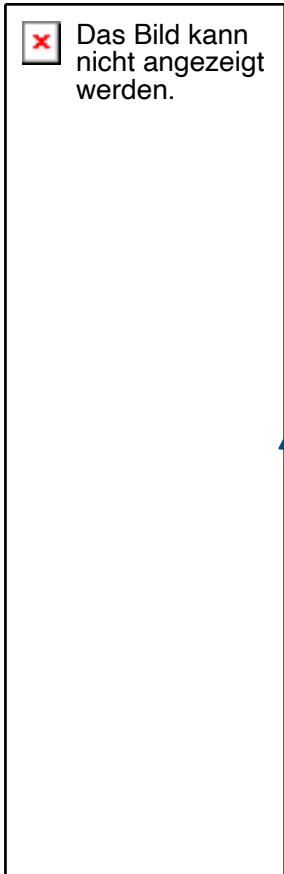
Singleton



Prototype



Singleton

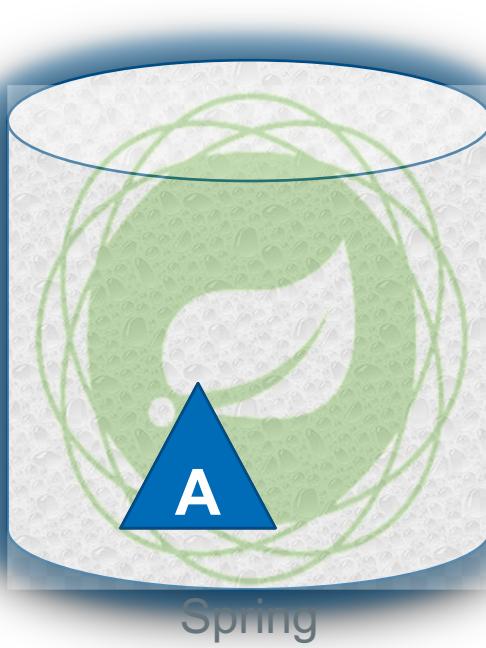


Spring



Singleton

Das Bild kann nicht angezeigt werden.



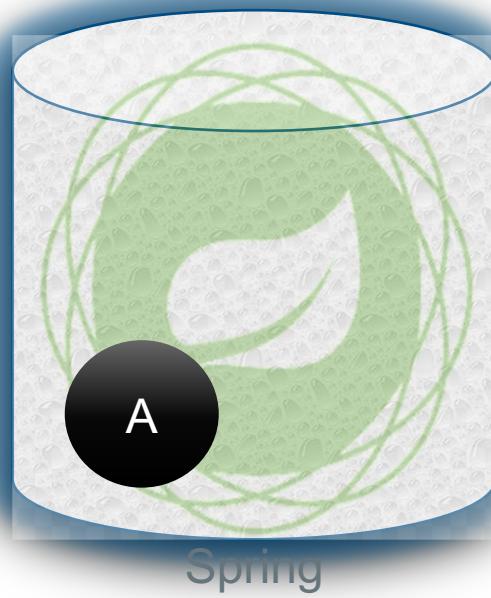
getBean(A.class)



Das Bild kann nicht angezeigt werden.



Prototype



getBean(A.class)

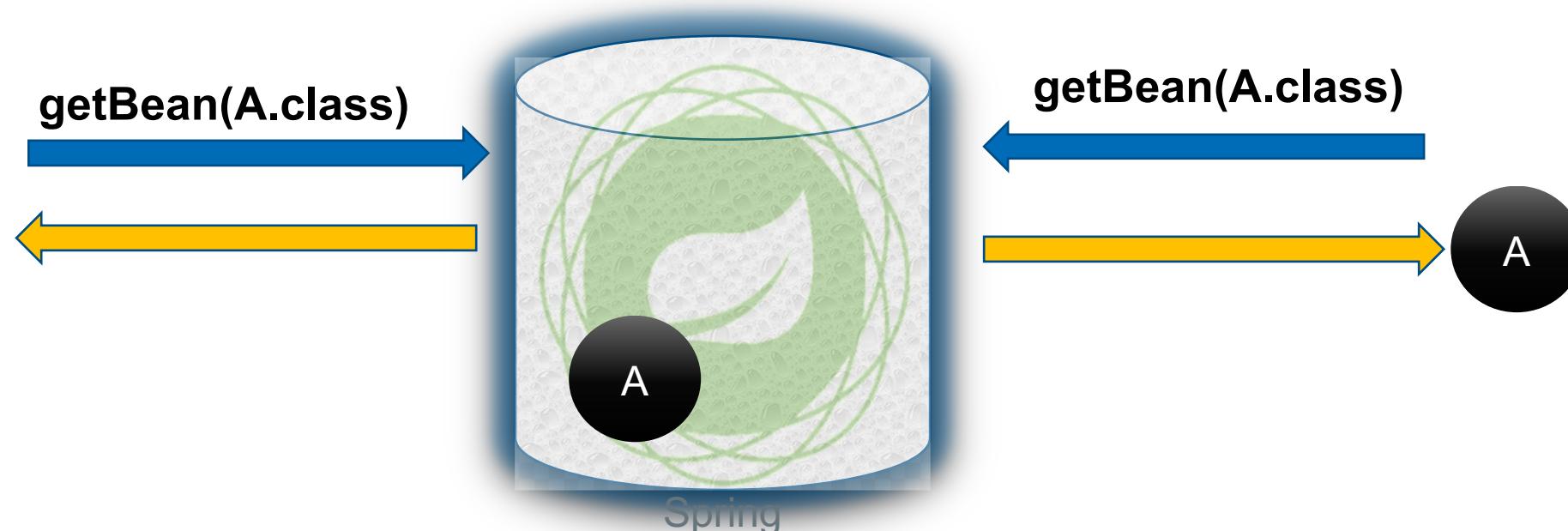


Das Bild kann nicht angezeigt werden.



Prototype

Das Bild kann nicht angezeigt werden.



Das Bild kann nicht angezeigt werden.

Singleton Example

```
@ComponentScan("ch.javaprofi_academy")
public class BeanScopesApp {
    public static void main(String[] args) {
        ClassPathXmlApplicationContext context =
            new ClassPathXmlApplicationContext("bean-def.xml");

        var shape1 = context.getBean(Shape.class);
        System.out.println(shape1);  Shape [color=yellow]

        shape1.setColor("blue");
        System.out.println(shape1);  Shape [color=blue]

        var shape2 = context.getBean(Shape.class);
        System.out.println(shape2);  Shape [color=blue]

        context.close();
    }
}
```

```
@Component
public class Shape {
    private String color = "yellow";
    //setter
}
```

Scope Configuration



`@Scope(scopeName=ConfigurableBeanFactory.SCOPE_PROTOTYPE)`

`@Scope(scopeName=ConfigurableBeanFactory.SCOPE_SINGLETON)`

`@Scope("prototype")`

`@Scope("singleton")`

`@Scope("somethingwrong")`

Caused by: `java.lang.IllegalStateException: No Scope registered for scope name 'somethingwrong'`

Prototype Example

```
@ComponentScan("ch.javaprofi_academy")
public class BeanScopesApp {
    public static void main(String[] args) {
        ClassPathXmlApplicationContext context =
            new ClassPathXmlApplicationContext("bean-def.xml");

        var shape1 = context.getBean(Shape.class);
        System.out.println(shape1);  Shape [color=yellow]

        shape1.setColor("blue");
        System.out.println(shape1);  Shape [color=blue]

        var shape2 = context.getBean(Shape.class);
        System.out.println(shape2);  Shape [color=yellow]

        context.close();
    }
}
```

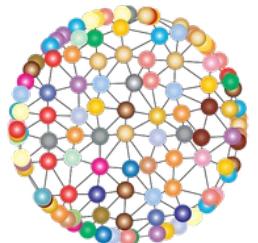
```
@Component
@Scope("prototype")
public class Shape {

    private String color = "yellow";

    //setter

}
```

```
};
```



What does singleton mean for Java? Where is the uniqueness given?



Singleton is per container and not per classloader (JVM)



```
@ComponentScan("ch.karthi")
public class App {

    public static void main(String[] args) {
        var container = new AnnotationConfigApplicationContext(App.class);
        var container2 = new AnnotationConfigApplicationContext(App.class);

        var shape1 = container.getBean(Shape.class);
        LOG.info(shape1);  INFO: Shape [color=yellow]

        shape1.setColour("blue");
        LOG.info(shape1);  INFO: Shape [color=blue]

        var shape2 = container2.getBean(Shape.class);
        LOG.info(shape2);  INFO: Shape [color=yellow]
    }
}
```

```
@Component
public class Shape {

    // shape
}
```



other singleton pitfalls



```
<?xml version="1.0" encoding="UTF-8"?>

<beans xmlns="http://www.springframework.org/schema/beans"
       xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
       xsi:schemaLocation="http://www.springframework.org/schema/beans
                           http://www.springframework.org/schema/beans/spring-beans.xsd">

    <bean id="scopeTest" class="ch.javaprofi_academy.Shape" scope="singleton">
        <property name="color" value="blue"/>
    </bean>

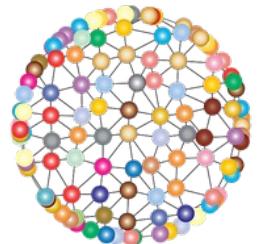
    <bean id="scopeTestDuplicate" class="ch.javaprofi_academy.Shape"
          scope="singleton">
        <property name="color" value="red"/>
    </bean>
</beans>
```



other singleton pitfalls



```
public class SingletonSurprise {  
    public static void main(String[] args) {  
        var ctx = new ClassPathXmlApplicationContext("shapes.xml");  
  
        Shape shape1 = ctx.getBean("scopeTest", Shape.class);  
        Shape shape2 = ctx.getBean("scopeTestDuplicate", Shape.class);  
  
        System.out.println(shape1 == shape2);  
        System.out.println(shape1 + " :: " + shape2);  
    }  
}
```



What is the output?



other singleton pitfalls



```
public class SingletonSurprise {  
    public static void main(String[] args) {  
        var ctx = new ClassPathXmlApplicationContext("shapes.xml");  
  
        Shape shape1 = ctx.getBean("scopeTest", Shape.class);  
        Shape shape2 = ctx.getBean("scopeTestDuplicate", Shape.class);  
  
        System.out.println(shape1 == shape2);           false  
        System.out.println(shape1 + " :: " + shape2);   Shape [color=blue]::Shape [color=red]  
    }  
}
```



other singleton pitfalls

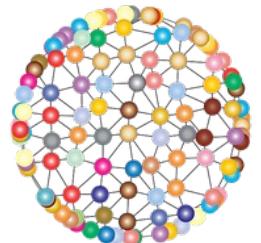


```
public class SingletonSurprise {
    public static void main(String[] args) {
        var ctx = new ClassPathXmlApplicationContext("shapes.xml");

        Shape shape1 = ctx.getBean("scopeTest", Shape.class);
        Shape shape2 = ctx.getBean("scopeTestDuplicate", Shape.class);

        System.out.println(shape1 == shape2);
        System.out.println(shape1 + "://" + shape2);

        Shape shape3 = ctx.getBean("scopeTest", Shape.class);
        Shape shape4 = ctx.getBean("scopeTestDuplicate", Shape.class);
        System.out.println(shape1 == shape3);
        System.out.println(shape2 == shape4);
        System.out.println(shape3 + "://" + shape4);
    }
}
```



What changes now?



other singleton pitfalls



```
public class SingletonSurprise {
    public static void main(String[] args) {
        var ctx = new ClassPathXmlApplicationContext("shapes.xml");

        Shape shape1 = ctx.getBean("scopeTest", Shape.class);
        Shape shape2 = ctx.getBean("scopeTestDuplicate", Shape.class);

        System.out.println(shape1 == shape2);          false
        System.out.println(shape1 + " :: " + shape2);  Shape [color=blue]::Shape [color=red]

        Shape shape3 = ctx.getBean("scopeTest", Shape.class);
        Shape shape4 = ctx.getBean("scopeTestDuplicate", Shape.class);
        System.out.println(shape1 == shape3);          true
        System.out.println(shape2 == shape4);          true
        System.out.println(shape3 + " :: " + shape4);  Shape [color=blue]::Shape [color=red]
    }
}
```



Fazit Singleton vs Prototype



Bean Scope

- The default one is Singleton. It is easy to change to Prototype





Life Cycle





Lifecycle Callbacks

- **Initialization Callbacks**

- @PostConstruct
- InitializingBean
- initMethod in @Bean



Precedence

- **Destruction Callback**

- @PreDestroy
- DisposableBean
- destroyMethod in @Bean



@PostConstruct



```
@Component
public class VideoPlayer {

    private AsmiqAcademyStream asmiqAcademyStream;
    private YoutubeStream youtubeStream;

    private String youtubeApiKey = "y7k8nd9d92d12m";
    private String asmiqAcademyApiKey = "y7k8nd9d92d12m";

    @PostConstruct
    private void initStreams() {
        asmiqAcademyStream =
            AsmiqAcademyStream.builder().withApiKey(asmiqAcademyApiKey).build();
        youtubeStream = YoutubeStream.builder().withApiKey(youtubeApiKey).build();
    }
}

<dependency>
<groupId>javax.annotation</groupId>
<artifactId>javax.annotation-api</artifactId>
<version>1.3.2</version>
</dependency>
```

InitializingBean



```
@Component
public class VideoPlayer implements InitializingBean {

    private AsmiqAcademyStream asmiqAcademyStream;
    private YoutubeStream youtubeStream;

    private String youtubeApiKey = "y7k8nd9d92d12m";
    private String asmiqAcademyApiKey = "y7k8nd9d92d12m";

    @Override
    public void afterPropertiesSet() throws Exception {
        initStreams();
    }

    private void initStreams() {
        asmiqAcademyStream =
            AsmiqAcademyStream.builder().withApiKey(asmiqAcademyApiKey).build();
        youtubeStream = YoutubeStream.builder().withApiKey(youtubeApiKey).build();
    }
}
```

initMethod in @Bean



```
@Component
public class VideoPlayer {

    private AsmiqAcademyStream asmiqAcademyStream;
    private YoutubeStream youtubeStream;

    private String youtubeApiKey = "y7k8nd9d92dl2m";
    private String asmiqAcademyApiKey = "y7k8nd9d92dl2m“;

    private void initStreams() {
        asmiqAcademyStream =
            AsmiqAcademyStream.builder().withApiKey(asmiqAcademyApiKey).build();
        youtubeStream = YoutubeStream.builder().withApiKey(youtubeApiKey).build();
    }
}
```

```
@Configuration
public class AppConfig {
    @Bean(initMethod = "initStreams")
    public VideoPlayer videoPlayer() {
        return new VideoPlayer();
    }
}
```

@Predestroy



```
@Component
public class VideoPlayer {

    private AsmiqAcademyStream asmiqAcademyStream;
    private YoutubeStream youtubeStream;

    private String youtubeApiKey = "y7k8nd9d92d12m";
    private String asmiqAcademyApiKey = "y7k8nd9d92d12m";

    @PreDestroy
    private void signOffStreams() {
        asmiqAcademyStream.signOff();
        youtubeStream.signOff();
    }

    public void run() {
        // start any of the stream
    }
}
```

DisposableBean



```
@Component
public class VideoPlayer implements DisposableBean {

    private AsmiqAcademyStream asmiqAcademyStream;
    private YoutubeStream youtubeStream;

    private String youtubeApiKey = "y7k8nd9d92d12m";
    private String asmiqAcademyApiKey = "y7k8nd9d92d12m";

    @Override
    public void destroy(){
        signOffStreams ();
    }

    private void signOffStreams() {
        asmiqAcademyStream.signOff();
        youtubeStream.signOff();
    }
}
```

destroyMethod in @Bean



```
@Component
public class VideoPlayer {

    private AsmiqAcademyStream asmiqAcademyStream;
    private YoutubeStream youtubeStream;

    private String youtubeApiKey = "y7k8nd9d92dl2m";
    private String asmiqAcademyApiKey = "y7k8nd9d92dl2m";

    private void signOffStreams() {
        asmiqAcademyStream.signOff();
        youtubeStream.signOff();
    }

    public void run() {
        // start any of the stream
    }
}
```

```
@Configuration
public class AppConfig {
    @Bean(destroyMethod = "signOffStreams")
    public VideoPlayer videoPlayer() {
        return new VideoPlayer();
    }
}
```



*Aware-Interfaces for special application cases

- Another way to get into the lifecycle is to implement XyzAware interfaces:

```
import org.springframework.beans.BeansException;
import org.springframework.beans.factory.BeanNameAware;
import org.springframework.context.ApplicationContext;
import org.springframework.context.ApplicationContextAware;
import org.springframework.stereotype.Component;

@Component
class MySpringBean implements BeanNameAware, ApplicationContextAware {

    @Override
    public void setBeanName(String name) {
        // ...
    }

    @Override
    public void setApplicationContext(ApplicationContext applicationContext)
        throws BeansException {
        // ...
    }
}
```

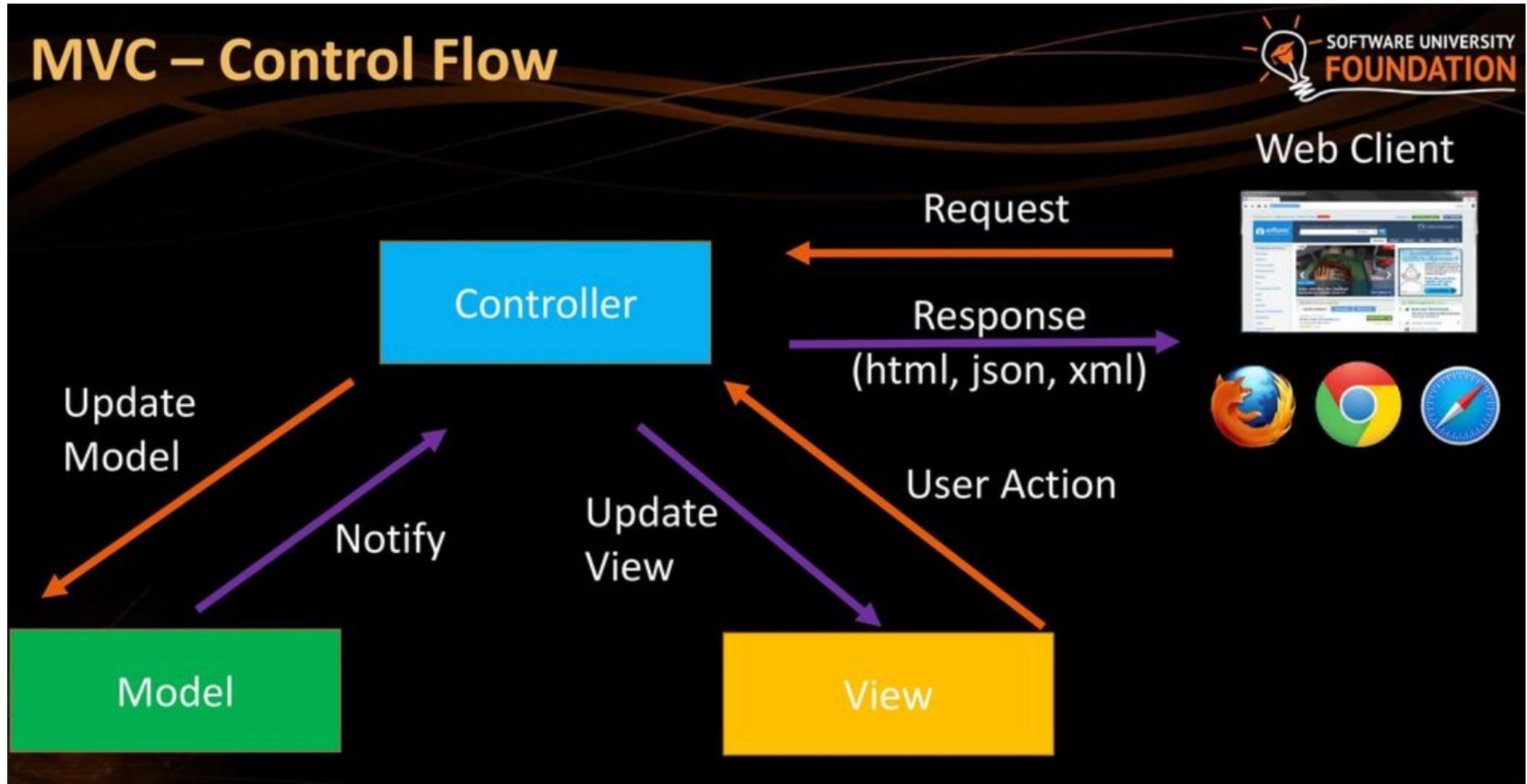


PART 4:

Spring MVC



MVC – Model View Controller – Logical Model

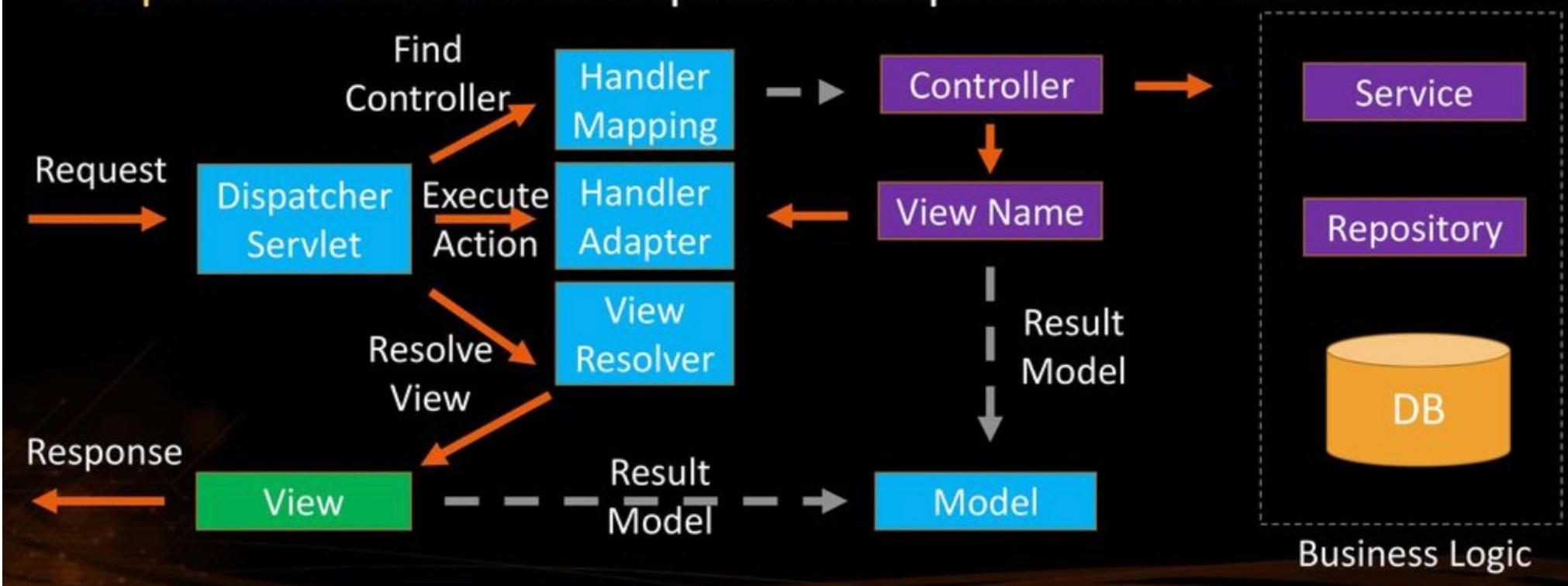




What is Spring MVC?



- Model-view-controller (MVC) framework is designed around a DispatcherServlet that dispatches requests to handlers



@Controller



```
@Target({ElementType.TYPE})
@Retention(RetentionPolicy.RUNTIME)
@Documented
@Component
public @interface Controller {

    /**
     * The value may indicate a suggestion for a logical component name,
     * to be turned into a Spring bean in case of an autodetected component.
     * @return the suggested component name, if any (or empty String otherwise)
     */
    @AliasFor(annotation = Component.class)
    String value() default "";

}
```



@Controller

@Controller

```
public class ShoppingBasket {
```

```
    @RequestMapping(name="/items", method=RequestMethod.GET)
```

```
    public String items() {
```

```
        // return the view name for the shopping lists
```

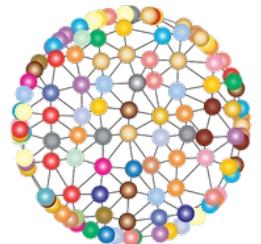
```
}
```

```
<<More request mapping methods>>
```

```
}
```

```
    public enum RequestMethod {  
        GET, HEAD, POST, PUT, DELETE, ...  
    }
```





What about REST?



REST-Controller based on Controller

```
@Controller  
public class ShoppingBasket{  
  
    @RequestMapping(name="/items", method=RequestMethod.GET)  
    @ResponseBody  
    public List<ShoppingItem> items(){  
        //return the shopping lists  
    }  
}
```



@RestController

Das Bildelement mit der Beziehungs-ID 102 wurde in der Datei nicht gefunden.

@Target(ElementType.TYPE)

@Retention(RetentionPolicy.RUNTIME)

@Documented

@Controller

@ResponseBody

public @interface RestController {

/**

* The value may indicate a suggestion for a logical component name,

* to be turned into a Spring bean in case of an autodetected component.

* @return the suggested component name, if any (or empty String otherwise)

* @since 4.0.1

*/

@AliasFor(annotation = Controller.class)

String value() default "";

}

@RestController



```
@Controller      @RestController
public class ShoppingBasket{

    @RequestMapping(name="/items", method=RequestMethod.GET)
    @ResponseBody
    public List<ShoppingItem> items(){
        //return the shopping lists
    }

}
```

@RestController



@RestController

```
public class ShoppingBasket{
```

```
    @GetMapping("/items")
```

```
    @RequestMapping(name="/items", method=RequestMethod.GET)
```

```
    public List<ShoppingItem> items(){
```

```
        //return the shopping lists
```

```
}
```

```
}
```



Shortcut Handler Methods

<code>@RequestMapping(... , method=RequestMethod.GET)</code>	<code>@GetMapping(..).</code>
<code>@RequestMapping(... , method=RequestMethod.POST)</code>	<code>@PostMapping(...).</code>
<code>@RequestMapping(... , method=RequestMethod.PUT)</code>	<code>@PutMapping(...).</code>
<code>@RequestMapping(... , method=RequestMethod.DELETE)</code>	<code>@DeleteMapping(...)</code>



produces => accept header

```
curl http://localhost:8080/items
```

```
@GetMapping("/items")
public List<ShoppingItem> items(){
    return items;
}
```

```
curl -H "accept: application/json" http://localhost:8080/items
```

```
@GetMapping(value="/items", produces=MediaType.APPLICATION_JSON_VALUE)
public List<ShoppingItem> itemsInJSON(){
    return items;
}
```

produces => accept header



```
curl -H "accept: application/xml" http://localhost:8080/items
```

```
@GetMapping(value="/courses", produces= { MediaType.APPLICATION_JSON_VALUE,  
                                         MediaType.APPLICATION_XML_VALUE })  
public List<ShoppingItem> getItems(){  
    return items;  
}  
  
<dependency>  
    <groupId>com.fasterxml.jackson.core</groupId>  
    <artifactId>jackson-core</artifactId>  
    <version>2.12.5</version>  
</dependency>  
<dependency>  
    <groupId>com.fasterxml.jackson.core</groupId>  
    <artifactId>jackson-databind</artifactId>  
    <version>2.12.5</version>  
</dependency>  
<dependency>  
    <groupId>com.fasterxml.jackson.dataformat</groupId>  
    <artifactId>jackson-dataformat-xml</artifactId>  
    <version>2.12.5</version>  
</dependency>
```



Get a particular item

```
@GetMapping("/items/{itemId}")
public ShoppingItem getItemById(@PathVariable String itemId){
    //return item with itemId
}
```

<http://host:port/items/1>

```
@GetMapping("/items")
public ShoppingItem getItemById(@RequestParam String itemId){
    //return item with itemId
}
```

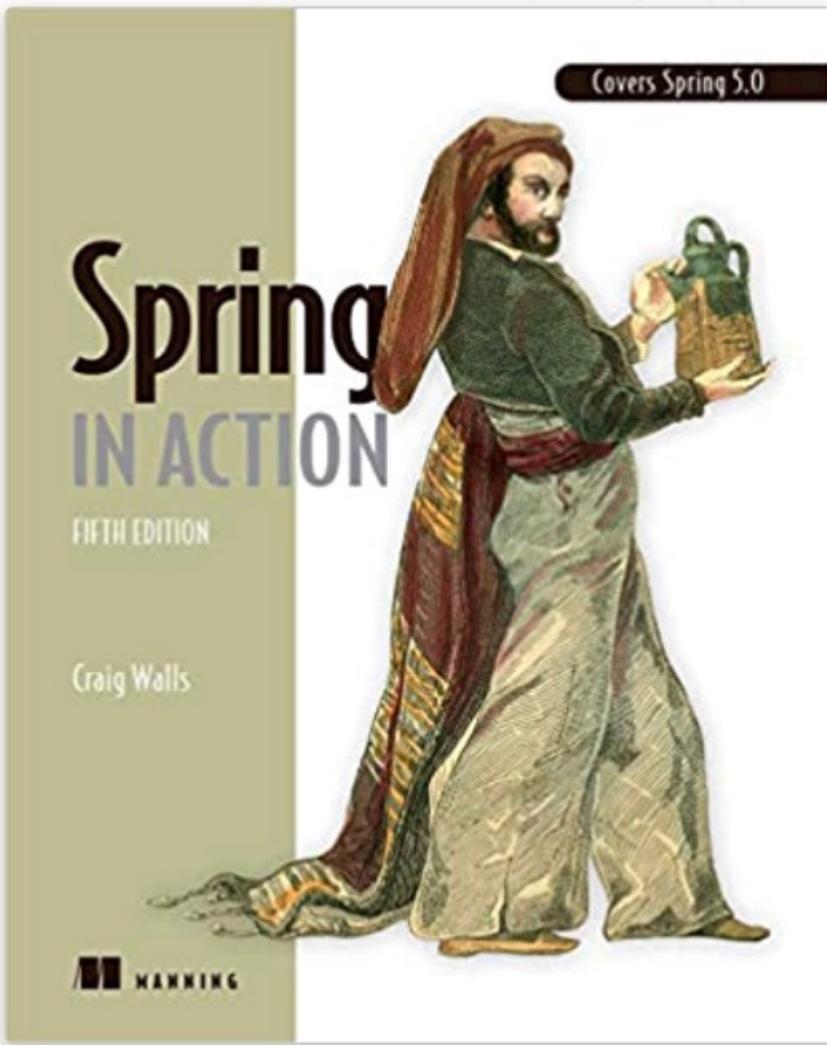
<http://host:port/items?itemId=1>



Questions?



Recommended books





Thank You