Spring and Spring Boot

Fundamentals

04.09.2024 Marius Reusch

About Me

About You

Name

(Company)

Java experience (in years)

Spring (Boot) experience (in years)

Experience with other enterprise frameworks, like Java EE (in years)

Breaks? Coffee ? Lunch?

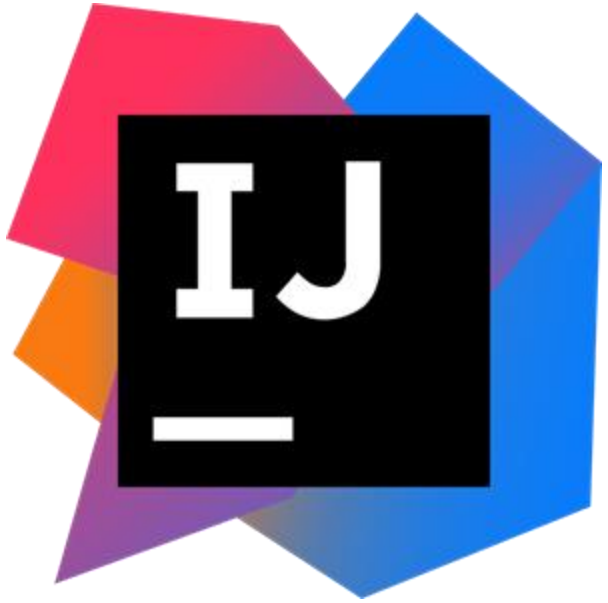
Agenda

- Introduction
- Spring?
- Spring Basics
- Spring Web / MVC
- Spring Boot
- Wrap-Up

Introduction / Objectives For Today

- Understand the core concepts of the Spring Framework
- Know the difference between Spring Framework, Spring MVC and Spring Boot
- Demystify the “magic” behind Spring and Spring Boot
- (Develop Rest Services with Spring)

Introduction / Versions (beside Spring)



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JDK 21

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Spring?

“Spring makes it easy to create **Java enterprise applications**. It provides everything you need to embrace the Java language in an enterprise environment. [...] Spring is **open source**.”

(https://docs.spring.io/spring/docs/current/spring-framework-reference/overview.html)

Spring? / Spring Projects

https://spring.io/projects

Spring? / Spring Projects

Spring Framework

Provides core support for dependency injection, transaction management, web apps, data access, messaging, and more.

6.1.12

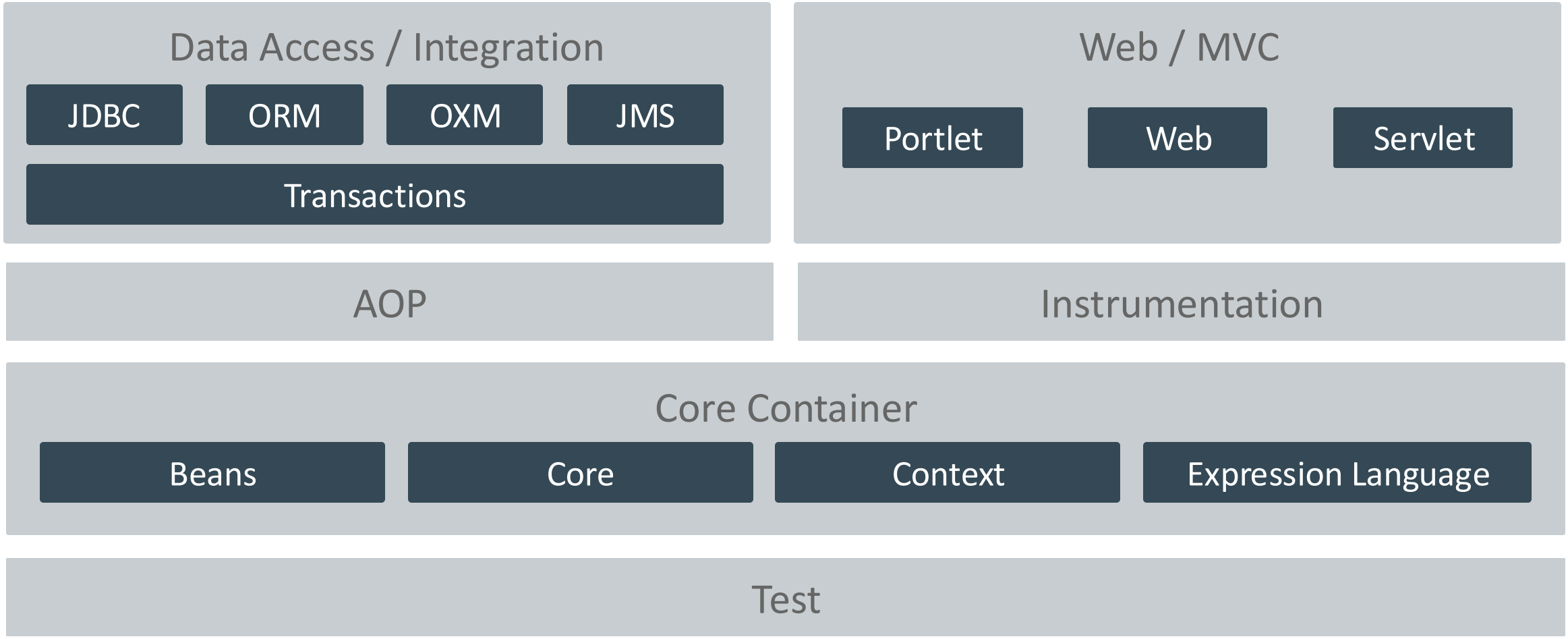
Spring Boot

Takes an opinionated view of building Spring applications and gets you up and running as quickly as possible.

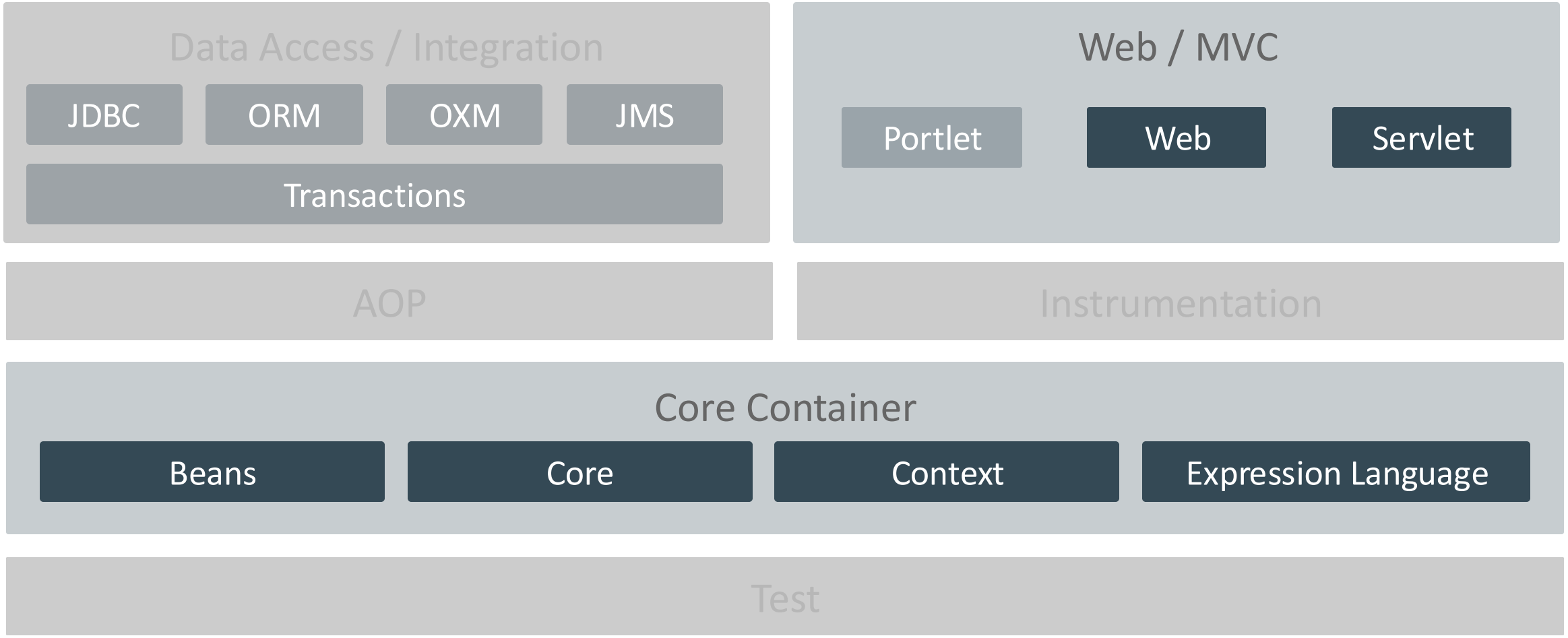
3.3.3

Spring Basics

Spring Basics / Spring Framework Modules



Spring Basics / Spring Framework Modules



Spring Basics / Topics

- Dependency Injection
- Beans
- Bean Stereotypes
- Bean Scopes
- Profiles and other Conditions
- Configuration
- Application Context Summary
- Wrap-Up

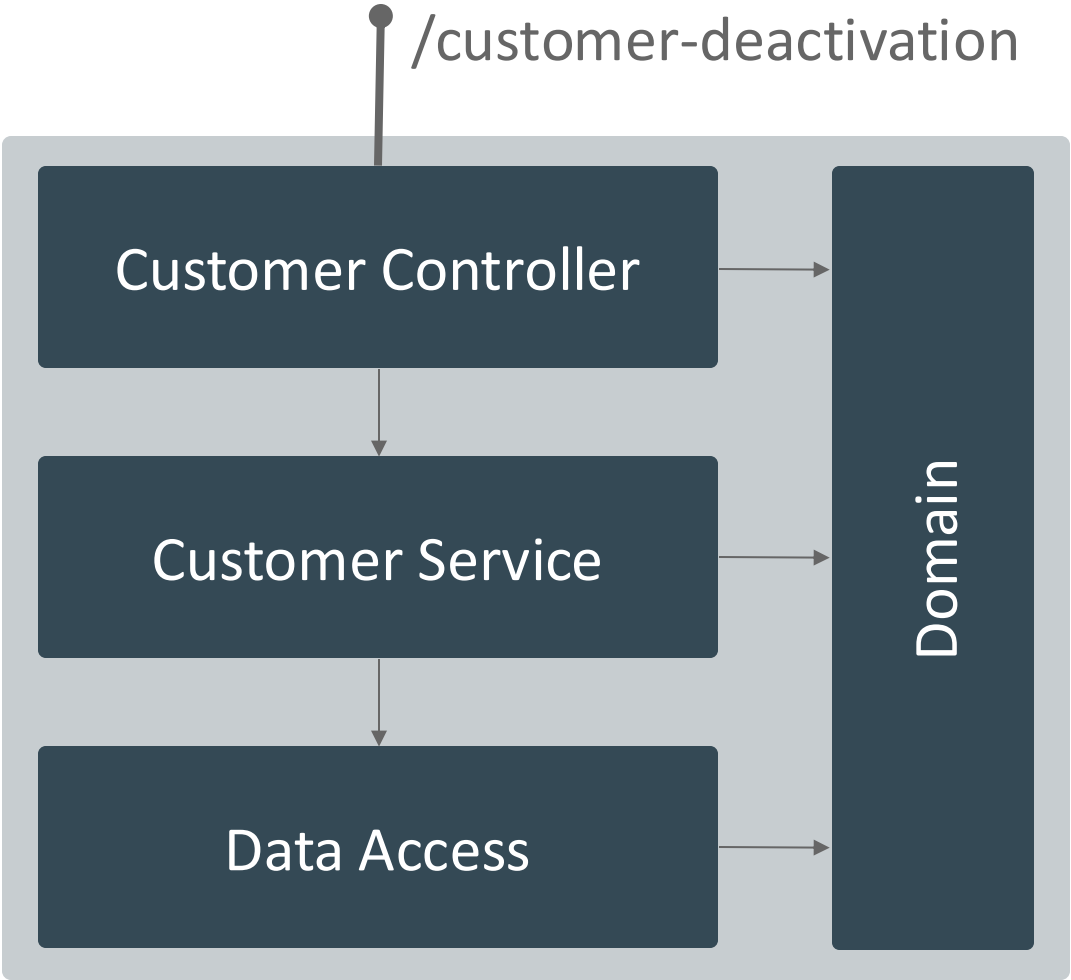
Spring Basics

Dependency Injection

Use Case: **Deactivate customer account**

In case of a successful deactivation, a letter should be sent to the customer. If an e-mail address is available, an e-mail should also be sent to the customer as confirmation.

Spring Basics / Dependency Injection



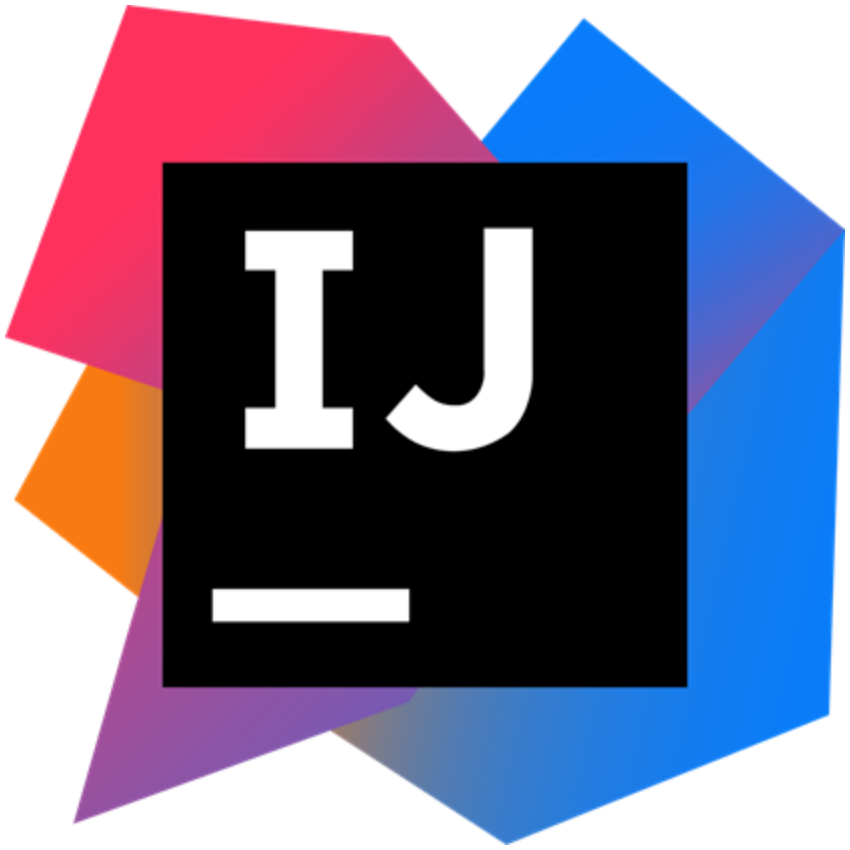
```java
public class CustomerService {

    static String DEACTIVATION_MESSAGE = "Your customer account has been successfully removed";

    public void deactivateCustomer(String customerId) {
        CustomerLoader customerLoader = new CustomerLoader();
        Customer customer = customerLoader.findById(customerId);

        if (customer.hasEmailAddress()) {
            String emailAddress = customer.getEmailAddress();
            EmailService emailService = new EmailService();
            emailService.send(emailAddress, "Customer Account", DEACTIVATION_MESSAGE);
        }

        PostalService postalService = new PostalService();
        postalService.sendLetter(customer.getMailingAddress(), DEACTIVATION_MESSAGE);
    }
}
```


IJ

Spring Basics / Dependency Injection

```
public class CustomerService {

    private final CustomerLoader customerLoader;
    private final EmailService emailService;

    public CustomerService(CustomerLoader customerLoader, EmailService emailService) {
        this.customerLoader = customerLoader;
        this.emailService = emailService;
    }
}
```

Constructor Injection

Spring Basics / Dependency Injection

```
public class CustomerService {

    private CustomerLoader customerLoader;
    private EmailService emailService;

    public void setCustomerLoader(CustomerLoader customerLoader) {
        this.customerLoader = customerLoader;
    }

    public void setEmailService(EmailService emailService) {
        this.emailService = emailService;
    }
}
```

Setter Injection

Spring Basics / Dependency Injection

```
public class CustomerService {

    public CustomerLoader customerLoader;
    public EmailService emailService;
    public PostalService postalService;
}
```

Naive approach with public fields. The dependency would be set by assigning it to the field

Field Injection

“Dependency Injection is a 25-dollar term for a 5-cent concept”

(James Shore)

Spring Basics / Dependency Injection

```
public static void main(String[] args) {

    EmailService emailService = new EmailService();
    PostalService postalService = new PostalService();
    CustomerLoader customerLoader = new CustomerLoader();
    CustomerService customerService = new CustomerService(emailService,
        postalService, customerLoader);

    CustomerController customerController = new CustomerController(customerService);

    customerController.deactivateCustomerAccount("1");
}
```

Do you see any problems here?

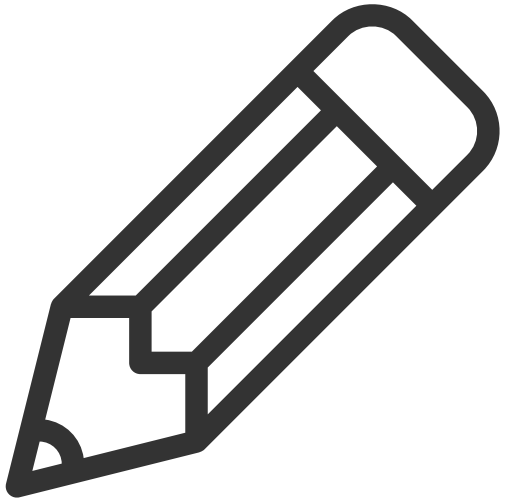
What could help us here?

Dependency Injection Frameworks to the rescue!

Dependency Injection Framework

Target: Spring should take care of “creating” and “assembling” our classes (and a lot of other stuff).

Imagine a box.



What do we need from the box?

Spring Basics / Dependency Injection

```
public static void main(String[] args) {

    EmailService emai[illegible] = new Emai[illegible]e();
    PostalService postal[illegible] = ne[illegible]lService();
    CustomerLoader customerL[illegible]CustomerLoader();
    CustomerService customerS[illegible]ew CustomerService(emailService,
        postalService, cus[illegible]de[illegible]

    CustomerController[illegible]tomerController[illegible]w CustomerController(customerService);

    customerController.deactivateCustomerAccount("1");
}
```

Spring Basics / Dependency Injection

```
public static void main(String[] args) {
    Box box = new Box();

    CustomerController customerController = box.get(CustomerController.class);

    customerController.deactivateCustomerAccount("1");
}
```

Hej Box, please give me an instance of my CustomerController!

Spring Basics

Beans

Beans?

Managed?

“Object managed by an IOC container”

Rod Johnson

This is our “box”

But how can we tell the “box” which classes should be considered as a Bean and to do all these crazy things for us? Any ideas?

Managed!

“A bean is an object that is **instantiated**, **assembled**, and **otherwise managed** by a Spring IoC container. ”

https://docs.spring.io/spring-framework/docs/current/spring-framework-reference/core.html#beans

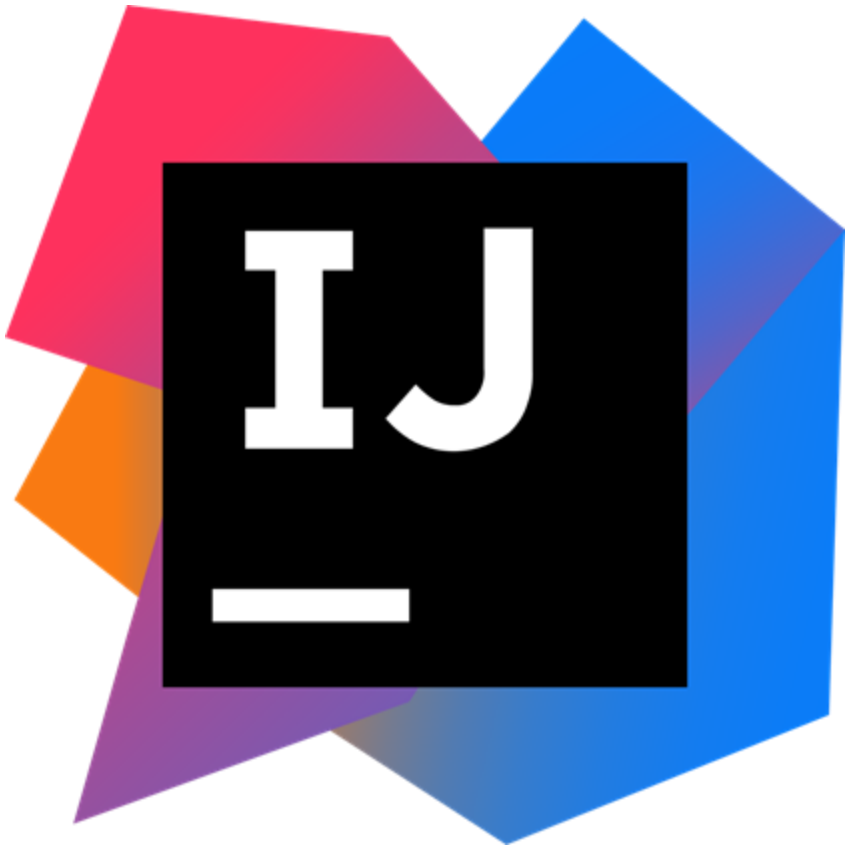
Later

This is our “box”

@Component

This annotation transforms a basic Java class (like the CustomerService) into a Bean managed by a container (our "box").

You can imagine the box as a container in which we put all the classes in that should be managed by Spring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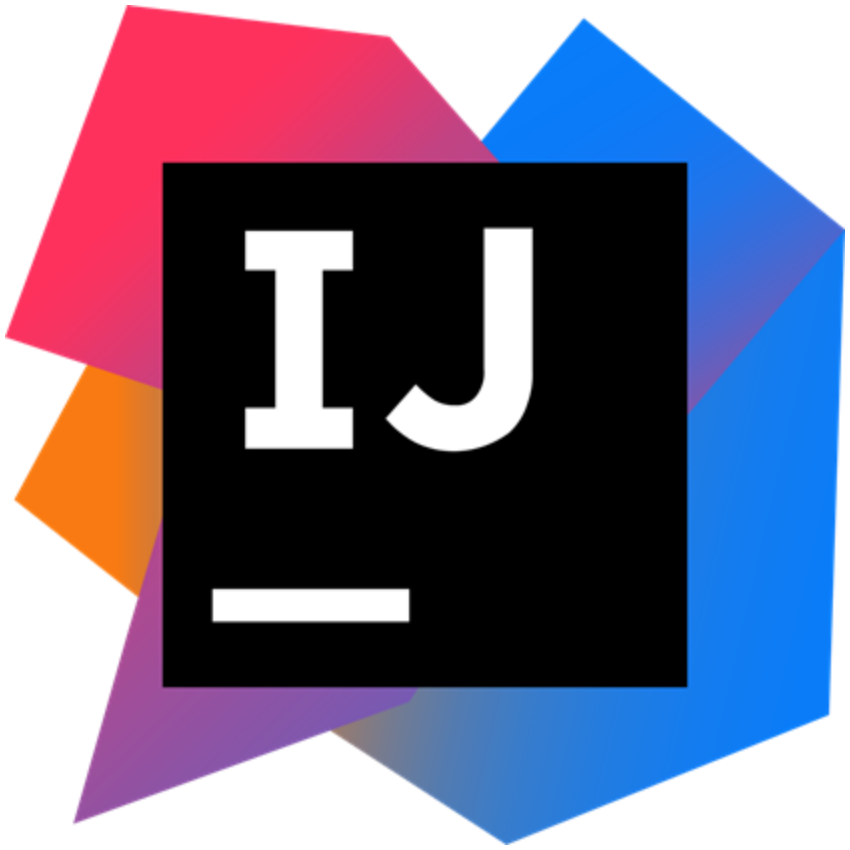
But how does the “box” know where to look for the Beans annotated with @Component?

The “box” doesn’t know!

@ComponentScan(“com.springfundamentals”)

This annotation tells the “box”, where it can search for components. It will search within this package and all its sub-packages. You can also omit all package information, then the package of the class annotated with this annotation will be the root package.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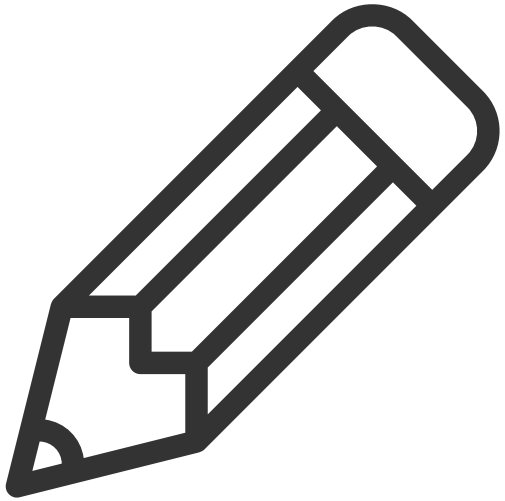
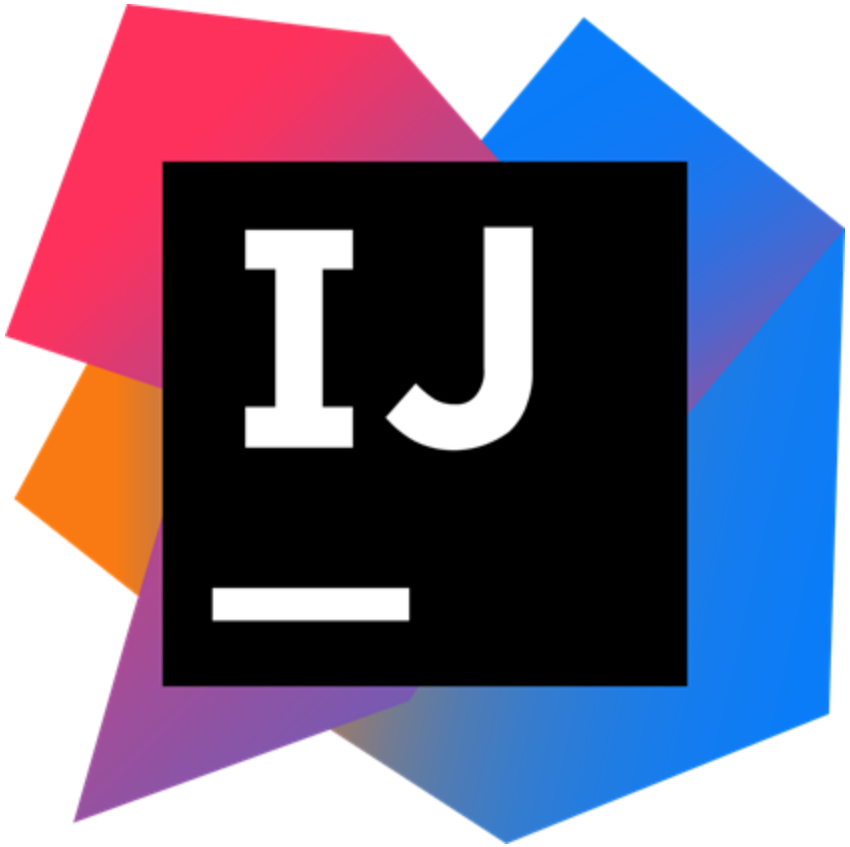


But in our project we use this **@Autowired** annotation…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@Autowired

This annotation is used to tell the “box” where it should inject a bean.

Spring Basics / Dependency Injection

```
@Component
public class CustomerService {

    private final CustomerLoader customerLoader;
    private final EmailService emailService;

    @Autowired
    public CustomerService(CustomerLoader customerLoader, EmailService emailService) {
        this.customerLoader = customerLoader;
        this.emailService = emailService;
    }
}
```

can be omitted (in case of a single constructor)

Constructor Injection

The Spring team generally advocates constructor injection.

Spring Basics / Dependency Injection

```
@Component
public class CustomerService {
    private CustomerLoader customerLoader;
    private EmailService emailService;

    @Autowired
    public void setCustomerLoader(CustomerLoader customerLoader) {
        this.customerLoader = customerLoader;
    }

    @Autowired
    public void setEmailService(EmailService emailService) {
        this.emailService = emailService;
    }
}
```

Setter Injection

Setter injection can be useful for optional dependencies

Spring Basics / Dependency Injection

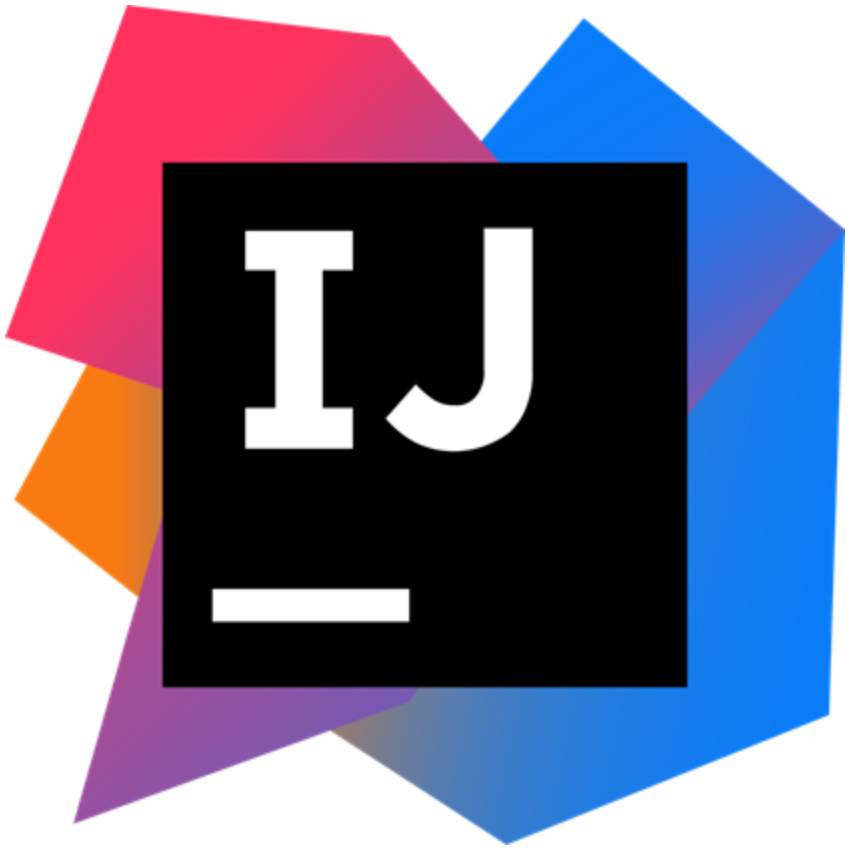
```
public class CustomerService {

    @Autowired
    private CustomerLoader customerLoader;

    @Autowired
    private EmailService emailService;
}
```

Not recommended! (at least not in production code)

Field Injection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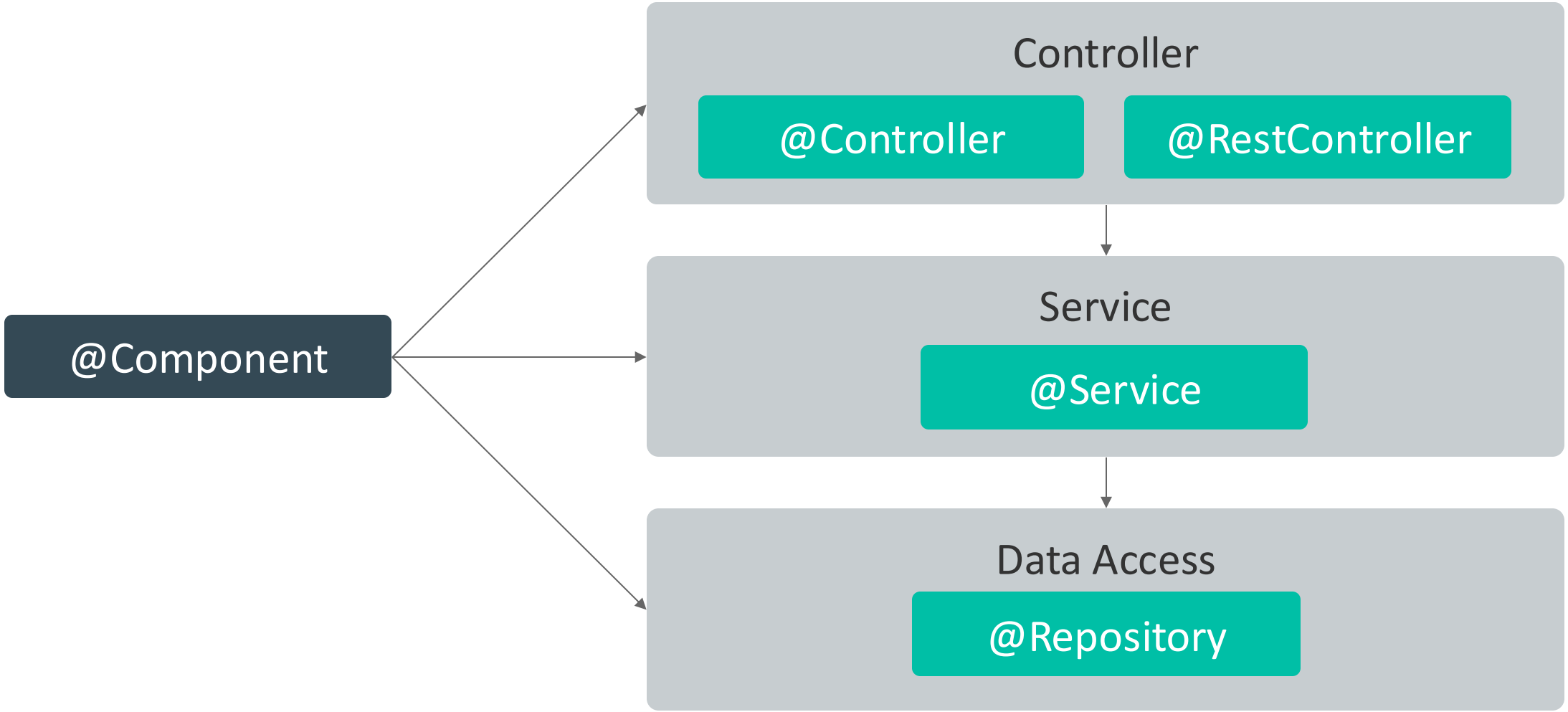
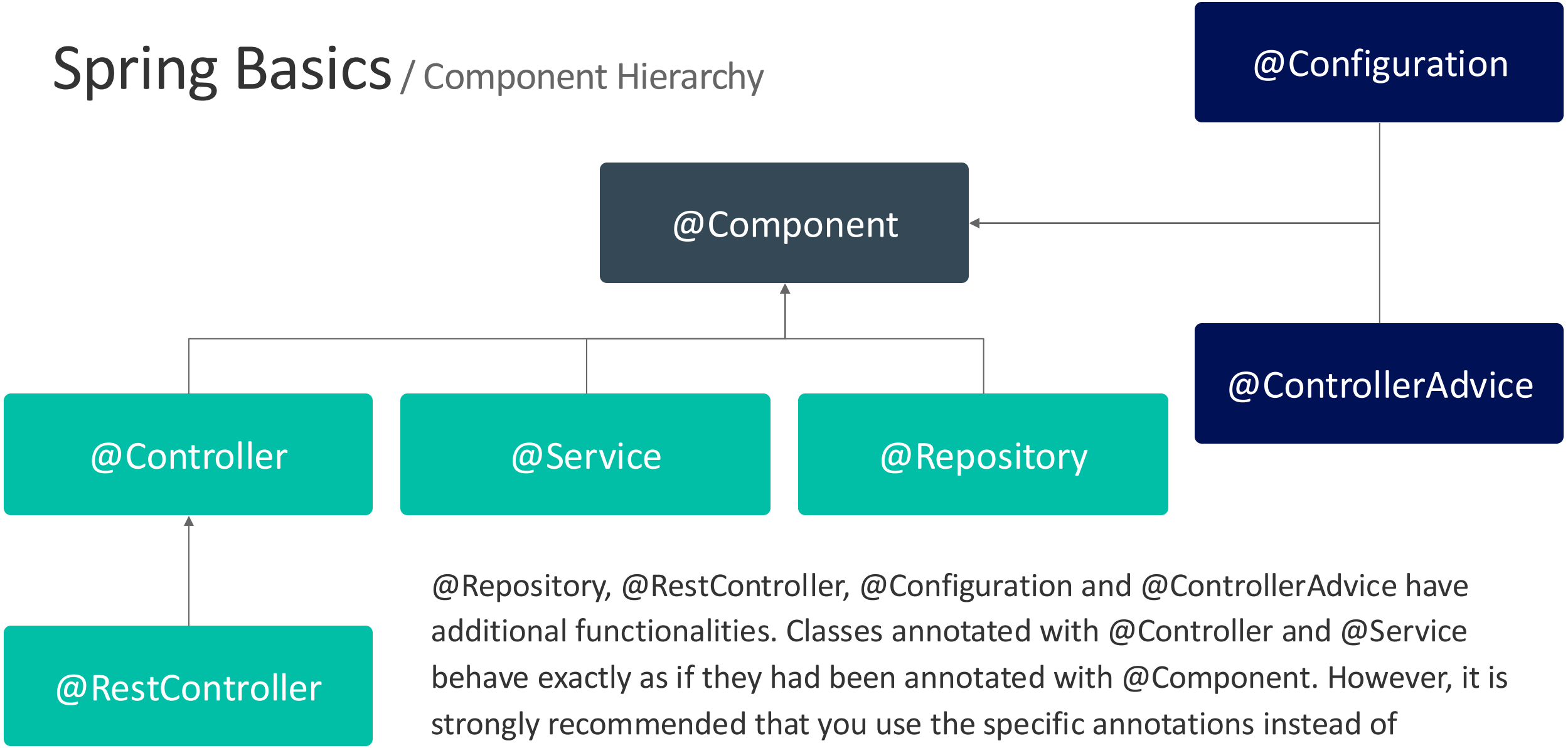
Spring Basics

Bean Stereotypes

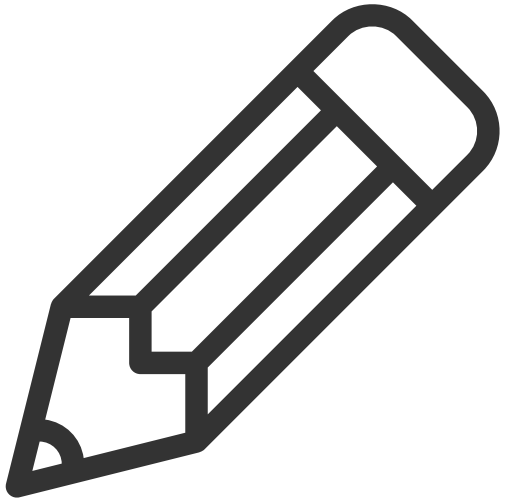
Spring Basics / Bean Stereotypes



Spring Basics / Component Hierarchy



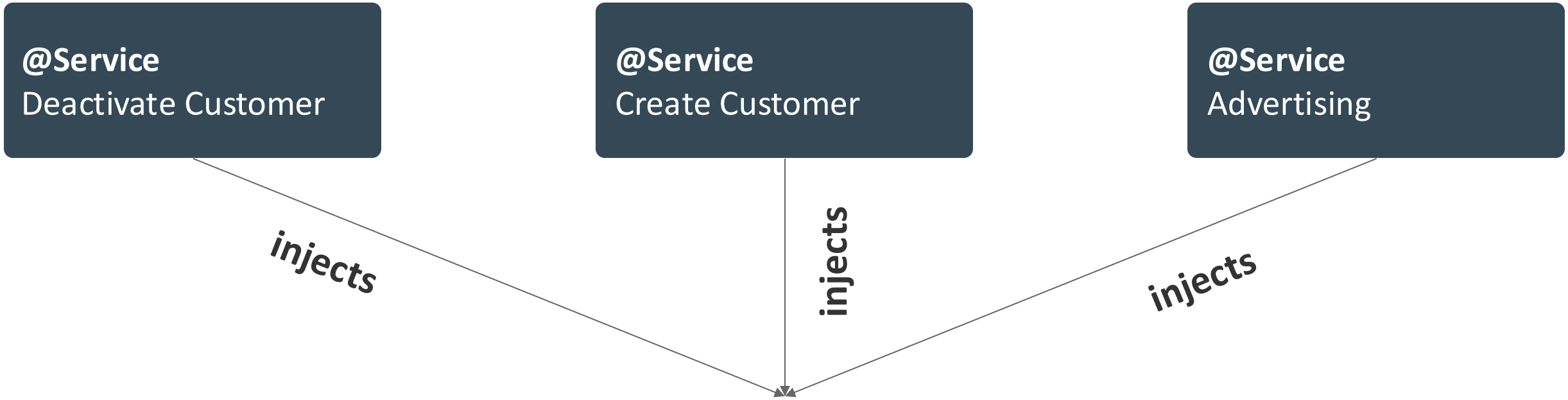
@Repository, @RestController, @Configuration and @ControllerAdvice have additional functionalities. Classes annotated with @Controller and @Service behave exactly as if they had been annotated with @Component. However, it is strongly recommended that you use the specific annotations instead of @Component.



Spring Basics

Bean Scopes

Spring Basics / Bean Scopes

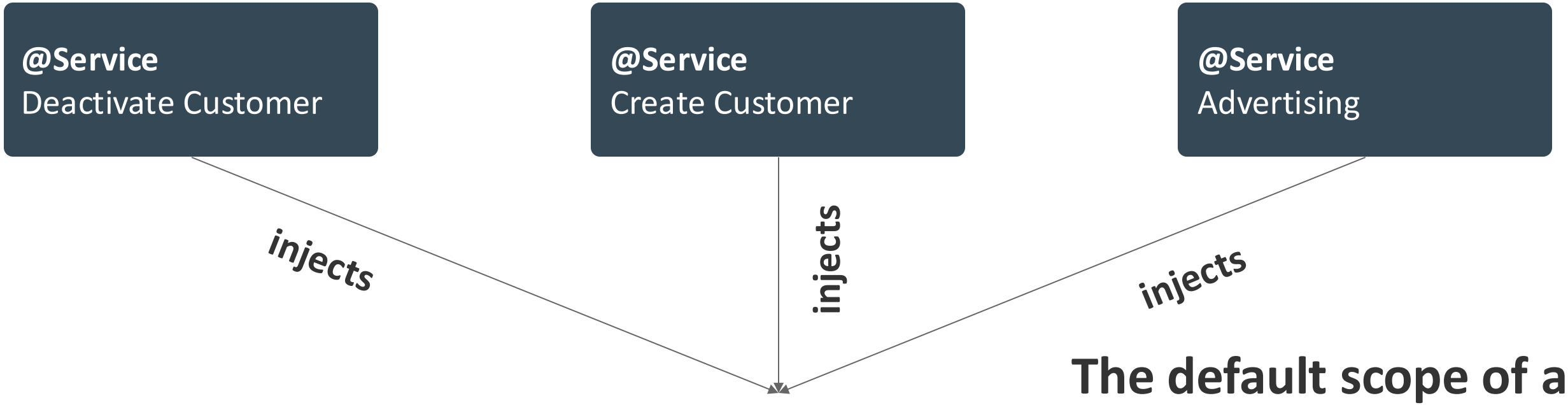



```
@Service
public class EmailService {
}
```

How many instances of the EmailService Bean do I have?

1

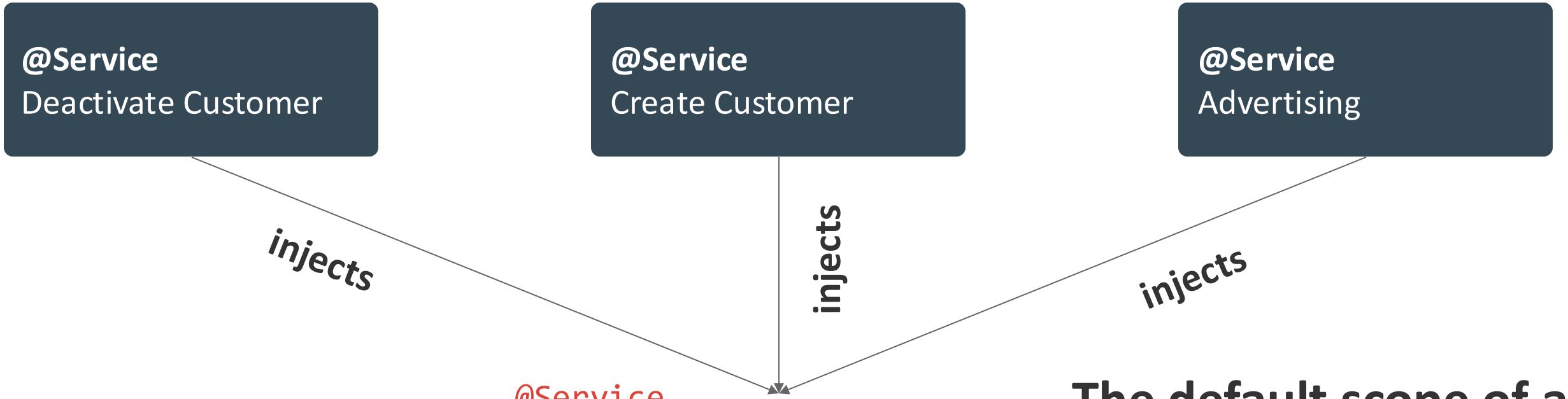
Spring Basics / Bean Scopes




```
@Service
public class EmailService {
}
```

The default scope of a Spring component is “singleton”.

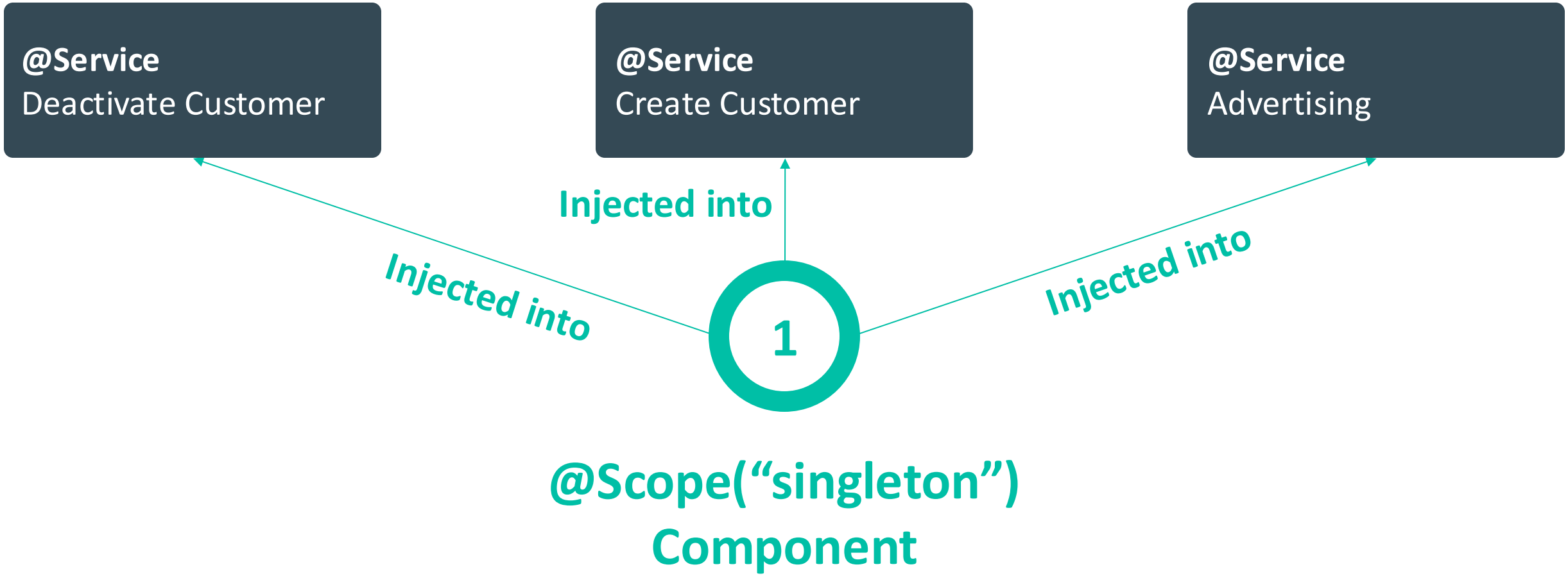
Spring Basics / Bean Scopes



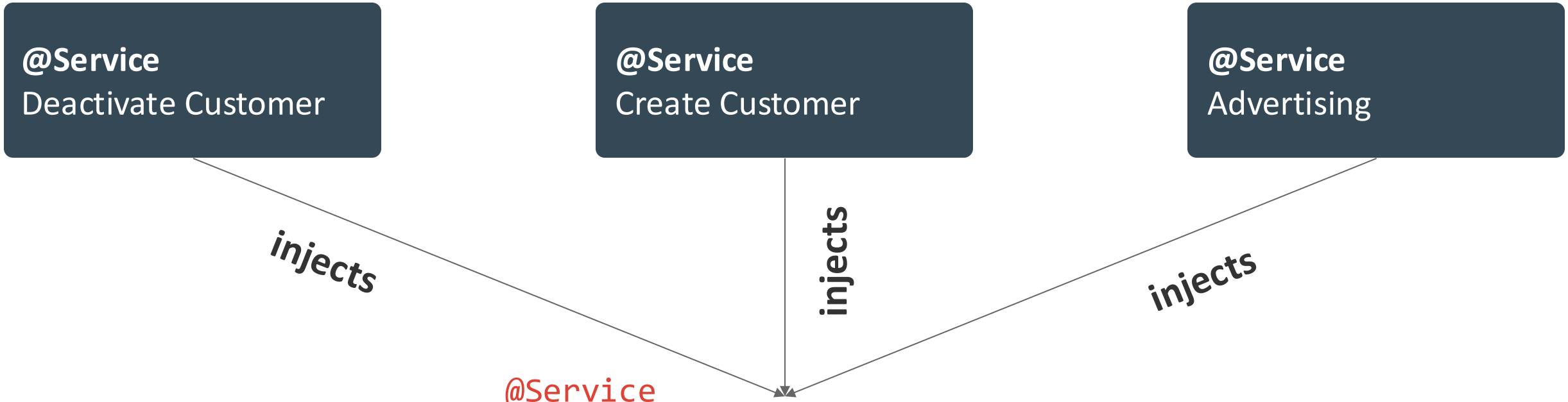

```
@Service
@Scope("singleton")
public class EmailService {
}
```

The default scope of a Spring component is "singleton".

Spring Basics / Bean Scopes



Spring Basics / Bean Scopes




```
@Service
@Scope("prototype")
public class EmailService {
}
```

There is one more scope.

Spring Basics / Bean Scopes

@Service
Deactivate Customer

@Service
Create Customer

@Service
Advertising

Injected into

Injected into

Injected into

1

2

3

@Scope("prototype")
Component

Spring Basics / Bean Scopes

- Singleton
- Prototype

Basic Spring Bean scopes. In most cases you need @Scope("singleton").

- Request
- Session
- Application
- Websocket

Basically you can use these four additional scopes in a Spring MVC project. But you will need them very rarely.

“As a rule, you should use the prototype scope for all stateful beans and the singleton scope for stateless beans.”

(https://docs.spring.io/spring/docs/5.1.3.RELEASE/spring-framework-reference/core.html#beans-factory-scopes-prototype)

“As a rule, you should use the prototype scope for all stateful beans and the singleton scope for stateless beans.”

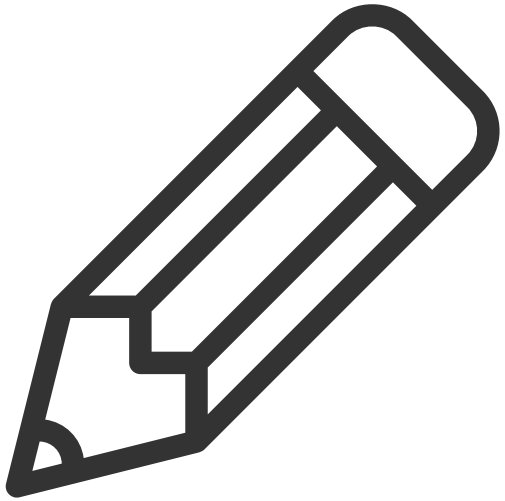
(https://docs.spring.io/spring/docs/5.1.3.RELEASE/spring-framework-reference/core.html#beans-factory-scopes-prototype)

What is your experience?

99.5% Singleton

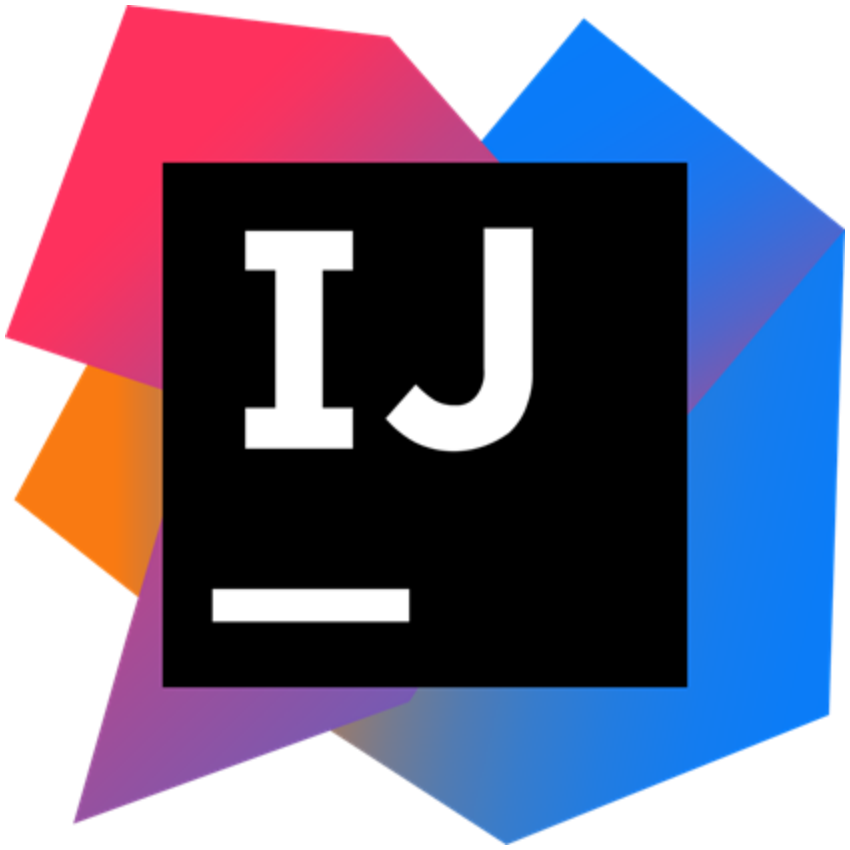
0.49 % RequestScope

0.01 % The rest



```java
@Service
public class SendEmailService {

    private String receiverAddress;

    public void sendEmail(String receiverAddress, String content) {
        this.receiverAddress = receiverAddress;

        someProcessing();

        send(content);
    }

    private void send(String content) {
        System.out.println("Send email with content " + content + " to " + this.receiverAddress);
    }

    private void someProcessing() {
        try {
            Thread.sleep(1000);
        } catch (InterruptedException e) {
            throw new RuntimeException(e);
        }
    }
}
```

Do you see any problems here?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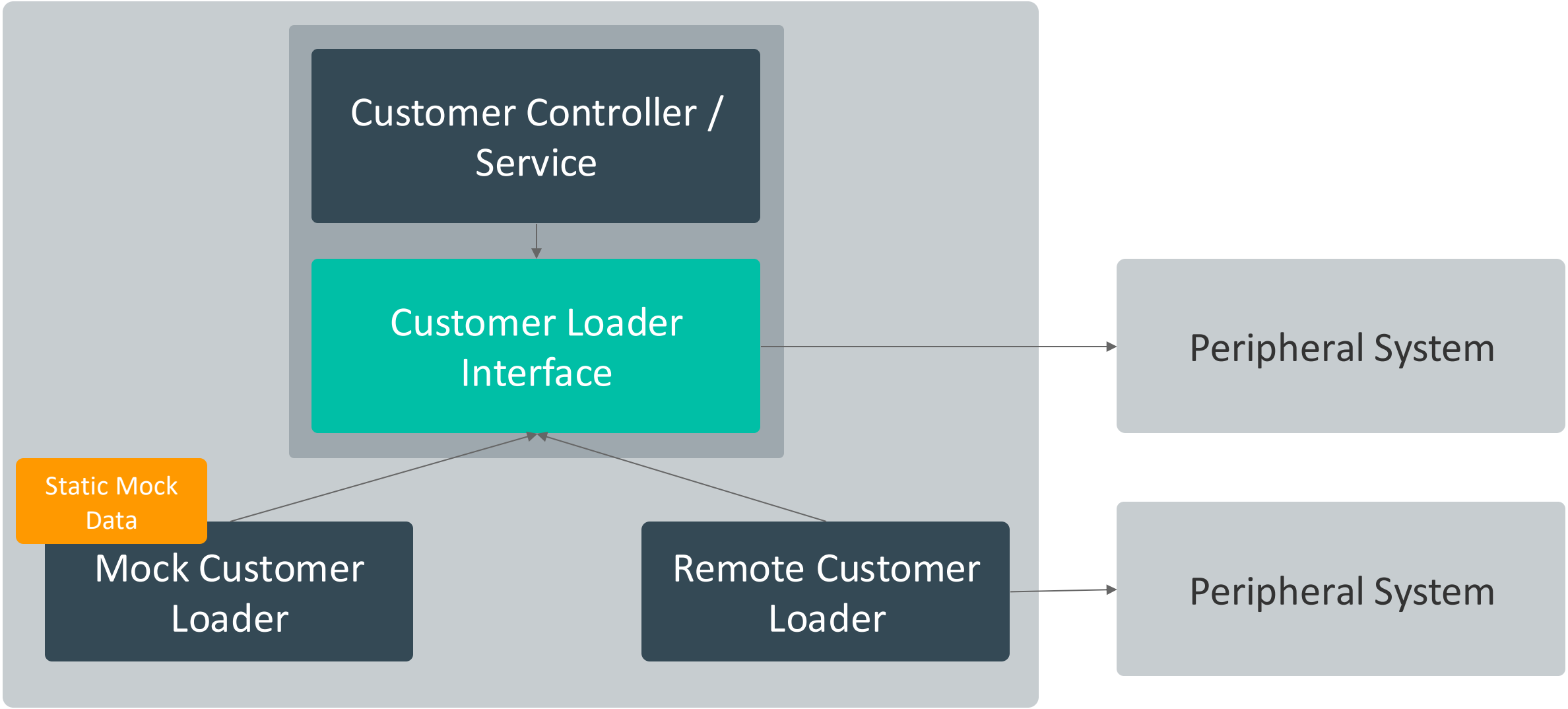
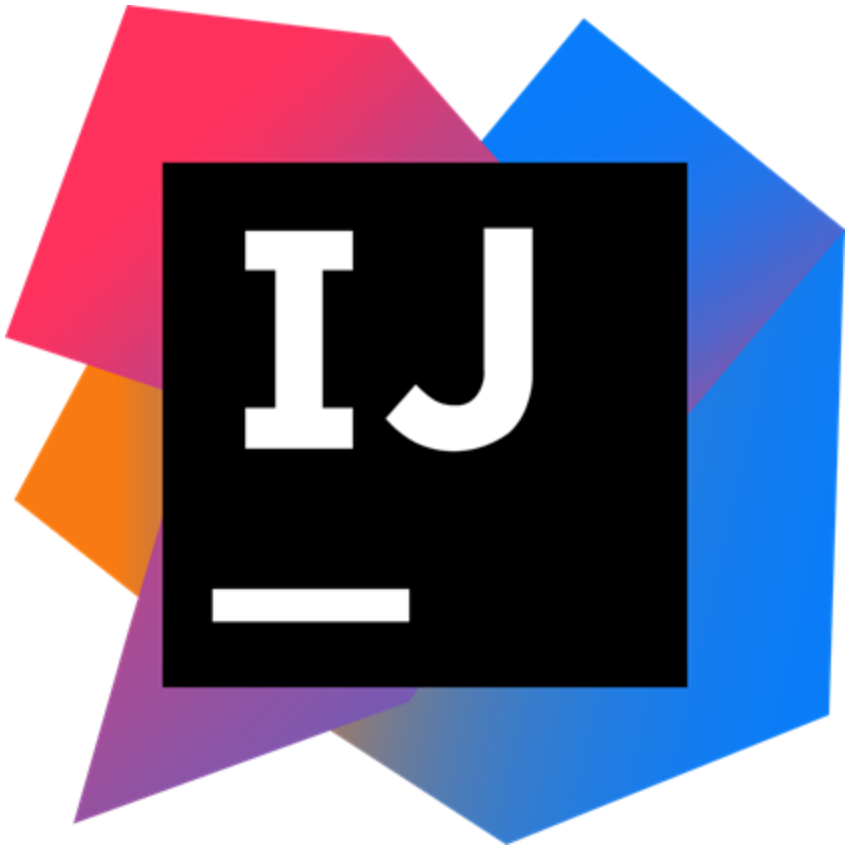
Spring Basics

Profiles and other Conditions

Spring Basics / Profiles and other Conditions

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Spring Basics / Profiles and other Conditions

```
@Component
@Profile("prod")
public class RemoteCustomerLoader implements CustomerLoader {

}
```

This component is only loaded if one of the active profiles is “prod”.

Yes, you can have more than one active profile.

Spring Basics / Profiles and other Conditions

```
@Component
@Profile("default")
public class MockCustomerLoader implements CustomerLoader {

}
```

If no active profile is set, the "default" profile is active.

But you can also set the default profile explicitly.

Spring Basics / Profiles and other Conditions

```
@Component
@Profile({"dev", "local"})
public class MockCustomerLoader implements CustomerLoader {

}
```

This component is only loaded if one of the active profiles is “dev” OR “local”.

No, @Profile does not support AND.

Spring Basics / Profiles and other Conditions

```
@Component
@Profile("!prod")
public class MockCustomerLoader implements CustomerLoader {

}
```

This component is only loaded if none of the active profiles is “prod”.

Spring Basics / Profiles and other Conditions

```
@Component
public class RemoteCustomerLoader implements CustomerLoader {

}
```

This would lead to a NoUniqueBeanDefinitionException

```
@Component
public class MockCustomerLoader implements CustomerLoader {

}
```

Spring Basics / Profiles and other Conditions

```
@Component
@Profile("prod")
public class RemoteCustomerLoader implements CustomerLoader {

}
```

Furthermore you can define custom conditions

```
@Component
@Conditional(LocalAndMockProfileCondition.class)
public class MockCustomerLoader implements CustomerLoader {

}
```

Spring Basics / Profiles and other Conditions

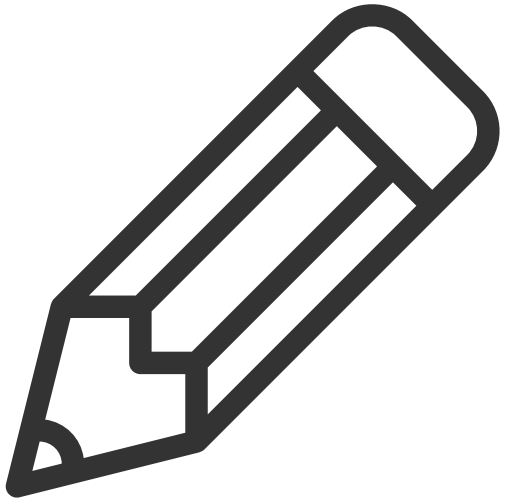
```
public class LocalAndMockProfileCondition implements Condition {

    @Override
    public boolean matches(ConditionContext context, AnnotatedTypeMetadata metadata) {
        List<String> activeProfiles = asList(context.getEnvironment().getActiveProfiles());
        return activeProfiles.contains("local") && activeProfiles.contains("mock");
    }
}
```

And you have access to the container

You can define any logic here

Summary: With conditions we can control whether a @Component is in our box or not.



Spring Basics

Configuration

Configuration in Spring

==

XML?

No!

We just developed a Spring application without a single line of XML!

But how did we do the configuration?

We used the **annotation based configuration**:

@ComponentScan

@Component (and its subtypes)

@Autowired

So there are **XML** **(avoid it)** and **annotations** **(prefer it)**, to configure Spring / our box...

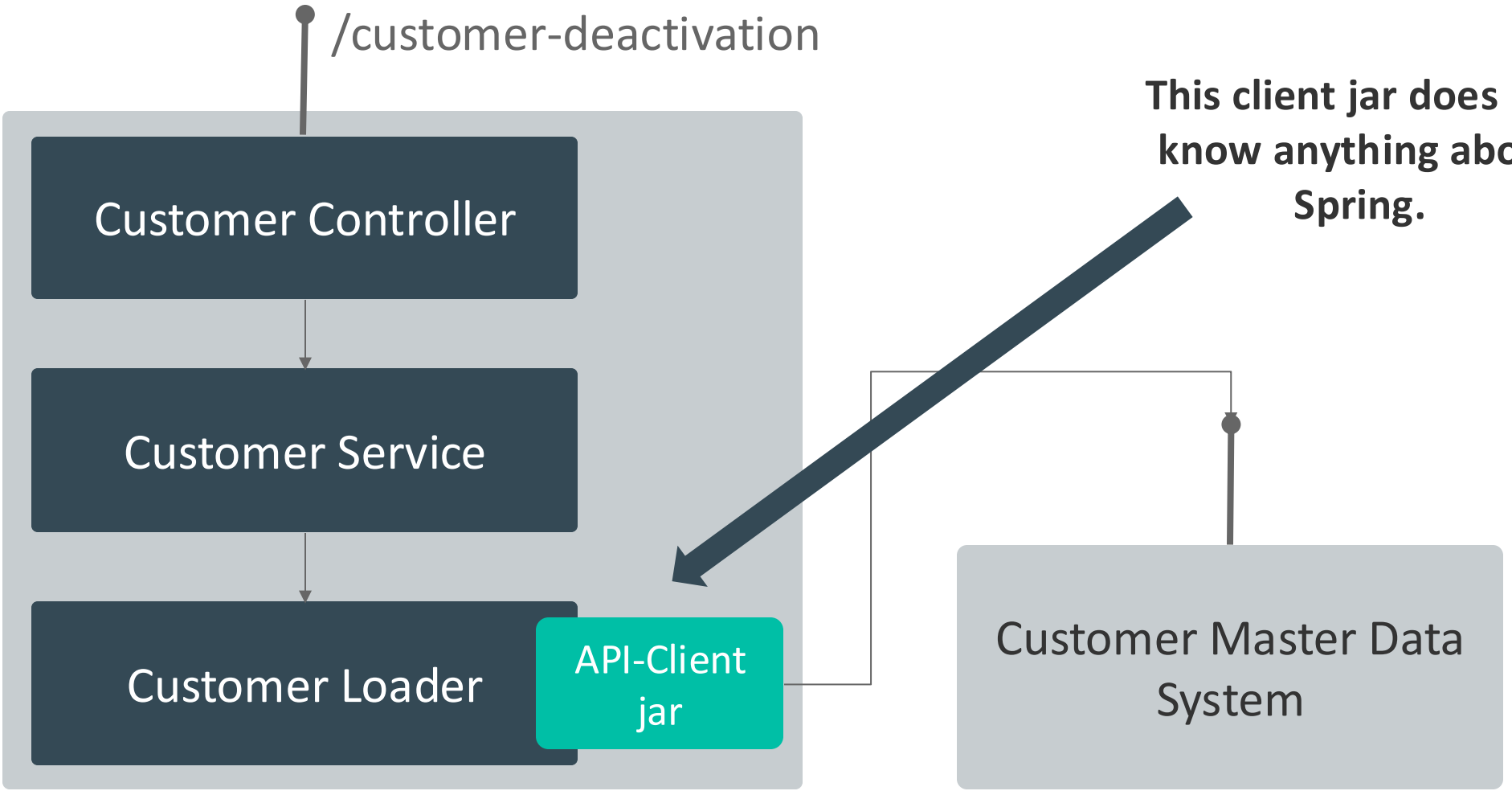
…but there is a third option.

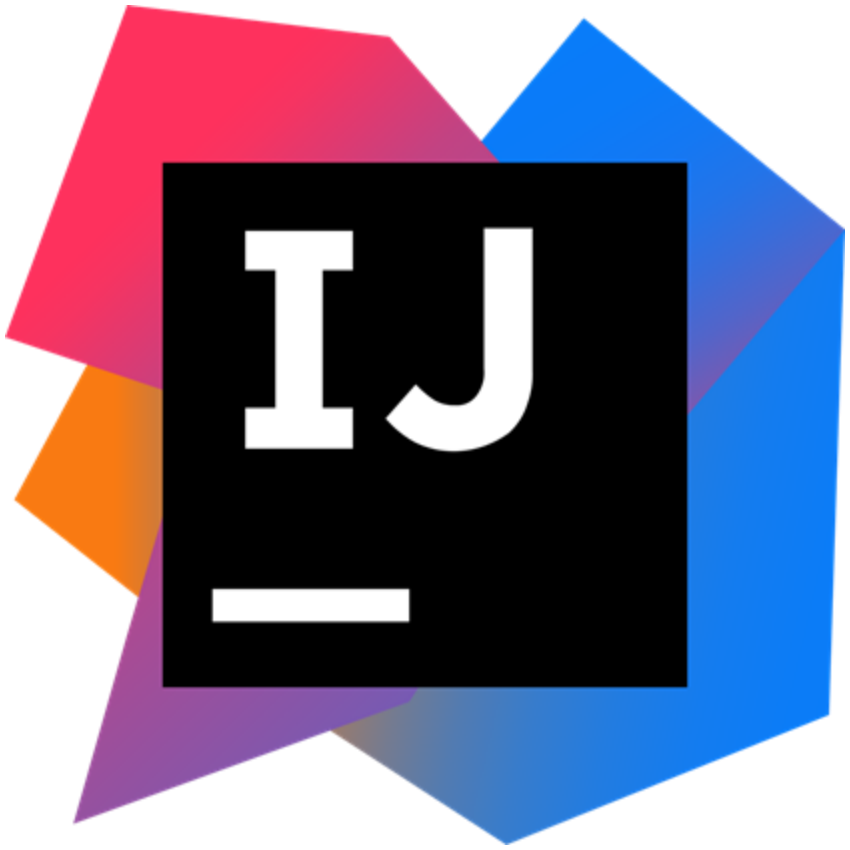
…but there is a third option.

Java-based configuration

Why do I need a third option?

Spring Basics / @Configuration

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We can define further Beans in theses classes with Bean factory methods (annotated with @Bean)

This annotation is also a @Component

@Configuration

Each Spring application can have multiple classes annotated with @Configuration.

There are many more annotations to configure Spring (@Enable…). These annotations should be placed on @Configuration classes

Spring Basics / Configuration

```
import com.acme.customermasterdata.api.CustomerMasterDataClient;

@Configuration
public class CustomerMasterDataApiConfiguration {

    @Bean
    public CustomerMasterDataClient cmdClient() {
        return new CustomerMasterDataClient();
    }
}
```

From third party library jar

Can be any name.

Spring Basics / Configuration

```
import com.acme.customermasterdata.api.CustomerMasterDataClient;


@Service
public class CustomerLoader {
    private final CustomerMasterDataClient customerMasterDataClient;

    @Autowired
    public CustomerLoader(CustomerMasterDataClient customerMasterDataClient) {
        this.customerMasterDataClient = customerMasterDataClient;
    }
}
```

And now we can inject the client class from the 3rd party lib with our regular mechanisms

Spring Basics / Configuration

annotation-based config

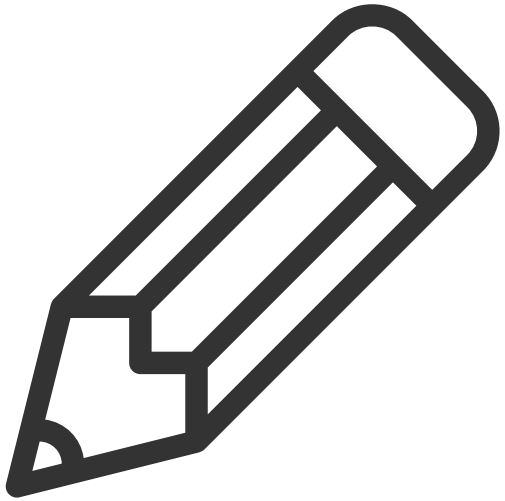
Java-based config

@Component (or rather @Service,...)

- Class-level annotation
- @Component is used to auto-detect beans using classpath scanning.
- Under normal circumstances we use this approach for defining our bean.

@Bean

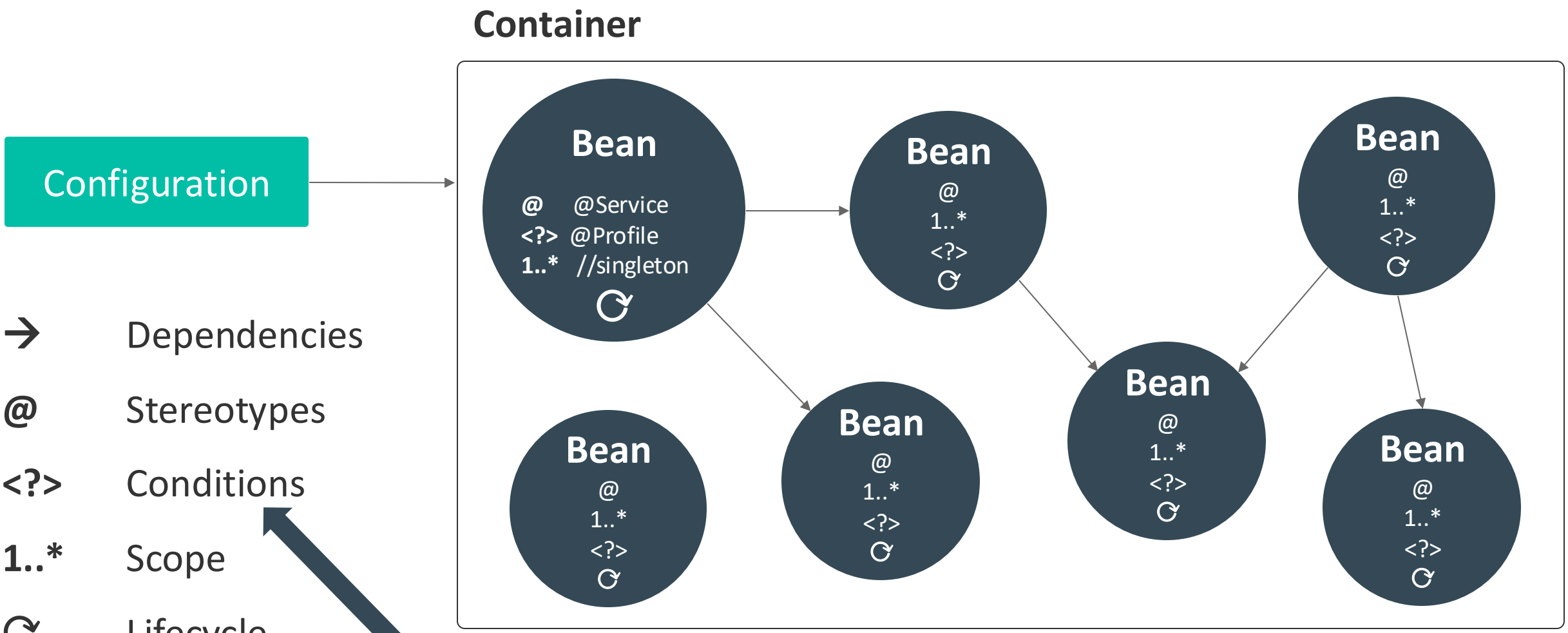
- Method-level annotation
- Decouples bean declaration and class definition.
- With @Bean you can add classes from non Spring-aware libraries to the applilcation context (i.e. third party libraries).
- Can be used to configure Spring-aware libraries.



Spring Basics

Application Context Summary

Spring Basics / Imagine a box



We will take up this topic again in the Spring Boot chapter.

Inversion of Control

General name for the “box” in Dependency Injection frameworks

Not the bean itself is controlling the instantiation or location of its dependencies.

(IoC) Container

The container will manage that and injects those dependencies when it creates the bean (Dependency Injection).

vs.

(Application) Context

In the Spring world, the container is represented by the so called application context.

FOR TODAY

Box == (IoC) Container == (Application) Context

Inversion of Control == Dependency Injection

Spring Basics

Wrap-up

What is a bean?

An object managed by the container.

Constructor-, Setter-, or Field Injection? And why?

Constructor Injection! Testing!

@Service or @Component? And Why?

@Service

- Annotation specific behavior
- Readability / Intention revealing
- You can use this it for your own purpose

I want to add a class (that is not under my control) to the application context. What annotation can support me here?

@Bean and @Configuration

Spring Basics / Wrap-up

- Prefer constructor injection over setter and field injection (especially in terms of unit testing).
- Always use the concrete stereotype (like @Service) instead of @Component.
- Use the request scope / prototype scope for all stateful beans and the singleton scope for stateless beans.
- There are three kinds of configuration: XML **(avoid this)**, Annotations **(prefer this)** and Java (@Configuration and @Bean) **(use if necessary)**

?

Spring Web / MVC

Spring Web / MVC / Topics

- Introduction
- REST Services with Spring

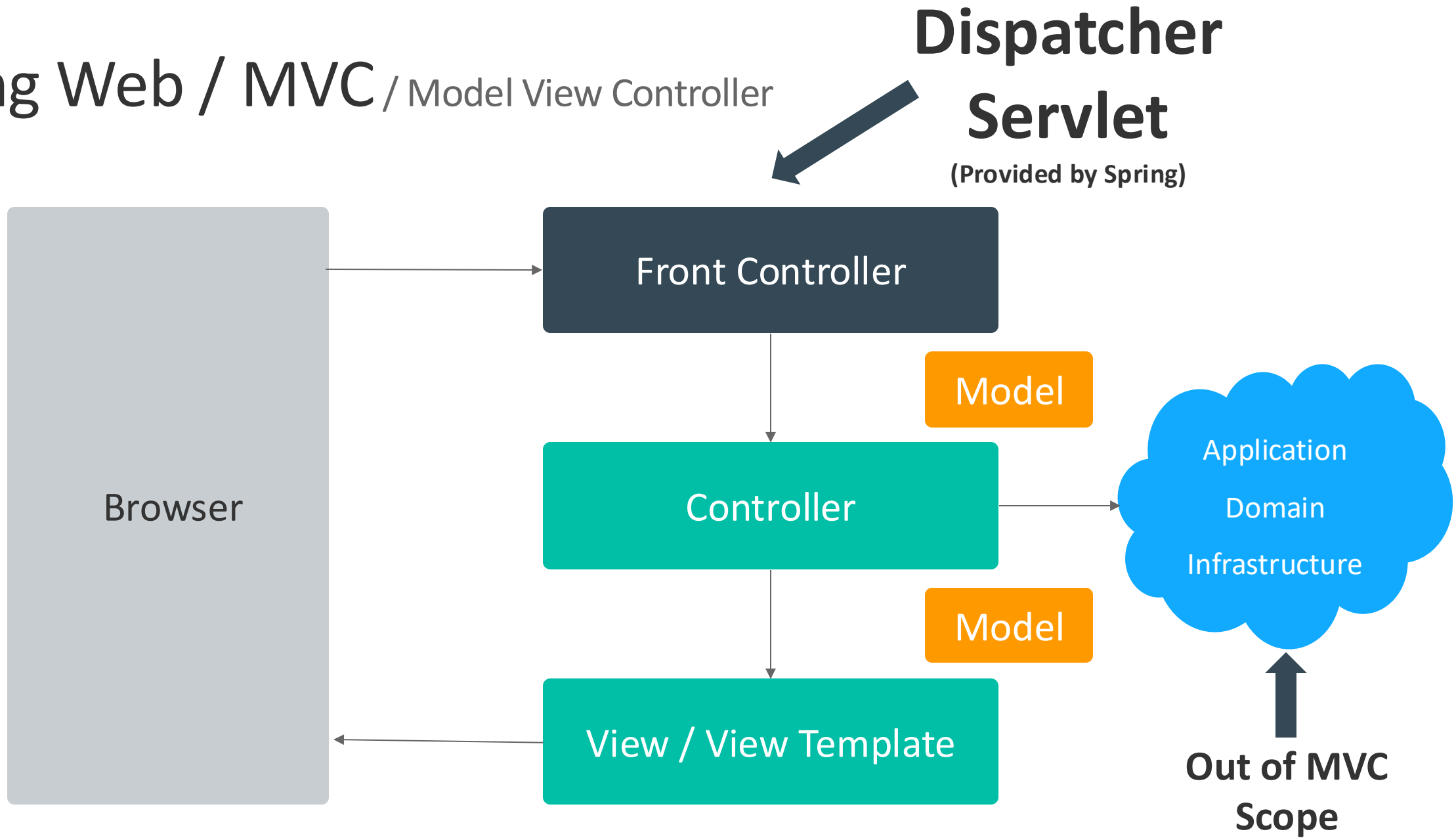
Spring Web / MVC

Introduction

“Spring Web MVC is the original **web framework** built on the **Servlet API** and has been included in the Spring Framework from the very beginning.”

(https://docs.spring.io/)

Spring Web / MVC / Model View Controller



Spring Web / MVC

REST Services with Spring

Spring Web / MVC / Important Annotations

- @RestController
- @RequestMapping
- @GetMapping
- @PostMapping
- @PutMapping
- @DeleteMapping
- @ResponseStatus
- @PathVariable
- @RequestParam
- @RequestBody

Spring Web / MVC / Important Annotations

@RequestParam

@GetMapping

GET http://localhost:8080/customers/**100**/addresses**?city=zurich**

@PathVariable

GET http://localhost:8080/customers/**100**/addresses**?city=zurich**

```
@RestController
public class CustomerRestController {

    @GetMapping("/customers/{id}/addresses")
    public List<CustomerDto> findBy(@PathVariable String id, @RequestParam String city)   {
        //implementation
    }
}
```

Spring Web / MVC / Important Annotations

@PostMapping

POST http://localhost:8080/customers

```
Content-Type: application/json
{
    "name" = "ACME"
}
```

@RequestBody

POST http://localhost:8080/customers

```
@RestController
public class CustomerRestController {

    @PostMapping
    public void create(@RequestBody CustomerDto customer) {
        //implementation
    }
}
```

Spring Web / MVC / Important Annotations

@PutMapping

PUT http://localhost:8080/customers/**100**

```
Content-Type: application/json
{
    "name" = "ACME Inc."
}
```

@PathVariable

@RequestBody

PUT http://localhost:8080/customers/**100**

```
@RestController
public class CustomerRestController {

    @PutMapping(”/customers/{id}")
    public CustomerDto update(@PathVariable String id, @RequestBody CustomerDto customer) {
        //implementation
    }
}
```

Spring Web / MVC / Important Annotations

@RequestParam

@DeleteMapping

DELETE http://localhost:8080/customers/**100**/addresses**?city=zurich**

@PathVariable

DELETE http://localhost:8080/customers/**100**

```
@RestController
public class CustomerRestController {

    @DeleteMapping(”/customers/{id}/addresses")
    public void delete(@PathVariable String customerId, @RequestParam String city) {
        //implementation
    }
}
```

@RequestMapping can be omitted (if no common path)

```
@RestController
@RequestMapping(”/customers")
public class CustomerRestController {

    @PostMapping
    public CustomerDto create(@RequestBody CustomerDto customer) { ... }

    @GetMapping
    public List<CustomerDto> findBy(@RequestParam Optional<String> name) { ... }

    @PutMapping(”/{id}")
    public CustomerDto update(@PathVariable String id, @RequestBody CustomerDto customer) { ... }

    @DeleteMapping(”/{id}")
    @ResponseStatus(HttpStatus.NO_CONTENT)
    public void delete(@PathVariable String customerId) { ... }
}
```

Optional indicates an optional request parameter

placeholder is required for @PathVariable

default is 200 (OK)

quick demo

Spring Web / MVC

Wrap-up

?

Spring Boot

Spring Boot / Topics

- What is Spring Boot?
- The first Spring Boot application
- Starters
- Auto Configuration
- Profiles, Properties and Externalized Configuration

Spring Boot?

Spring Boot is a framework for web applications!

No!

Spring Boot works with code generation!

No!

Spring Boot is a framework for building microservices!

Spring Boot / What is Spring Boot?

https://spring.io/projects/spring-boot

Spring Boot / What is Spring Boot?

"Spring embraces flexibility and is **not opinionated** about how things should be done. It supports a wide range of application needs with different perspectives."

(https://docs.spring.io/spring/docs/5.1.3.RELEASE/spring-framework-reference/overview.html#overview-philosophy)

Spring Framework

"We take an **opinionated** view of the Spring platform and third-party libraries, so that you can get started with minimum fuss." (https://docs.spring.io/spring-boot/docs/current/reference/htmlsingle/#getting-started-introducing-spring-boot)

Spring Boot

“Spring Boot is [...] a configuration wrapper around all of the Spring framework.”

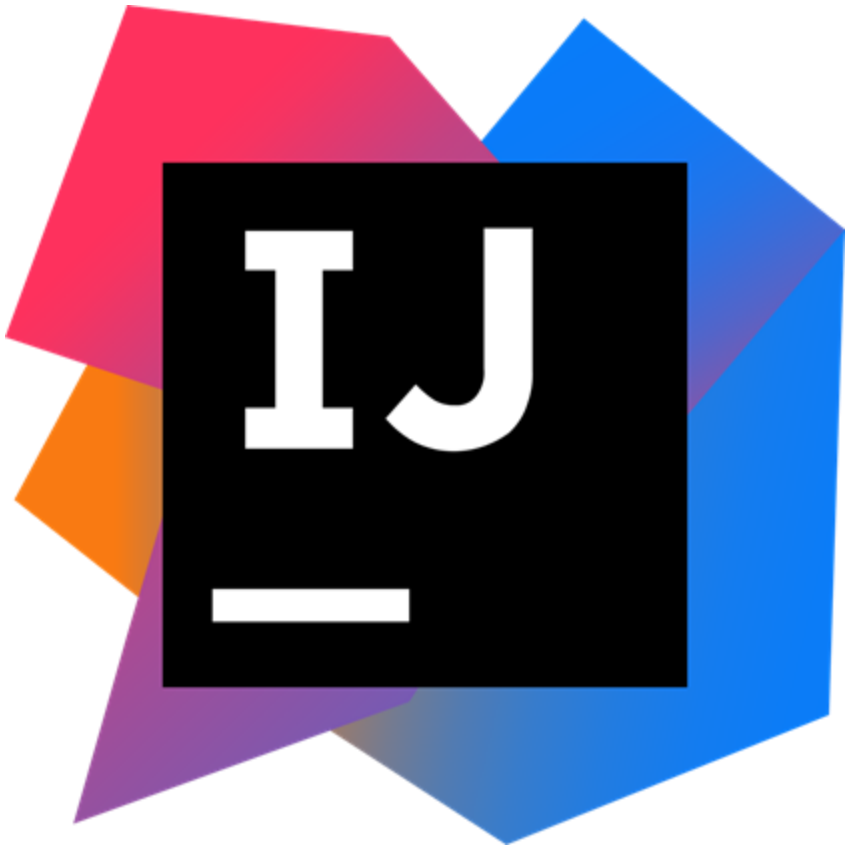
And a lot of other spring projects

Spring Boot

The first Spring Boot application

Spring Boot / Initializer

https://start.spring.io/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Spring Boot / @SpringBootApplication

```java
package com.springfundamentals;

import org.springframework.boot.SpringApplication;
import org.springframework.boot.autoconfigure.SpringBootApplication;

@SpringBootApplication
public class Application {
    public static void main(String[] args) {
        SpringApplication.run(Application.class, args);
    }
}
```

Spring Boot / @SpringBootApplication

@SpringBootApplication

@ComponentScan

- Scans for components in current package and all child packages
- Same as we already saw in the Spring Basics chapter

@EnableAutoConfiguration

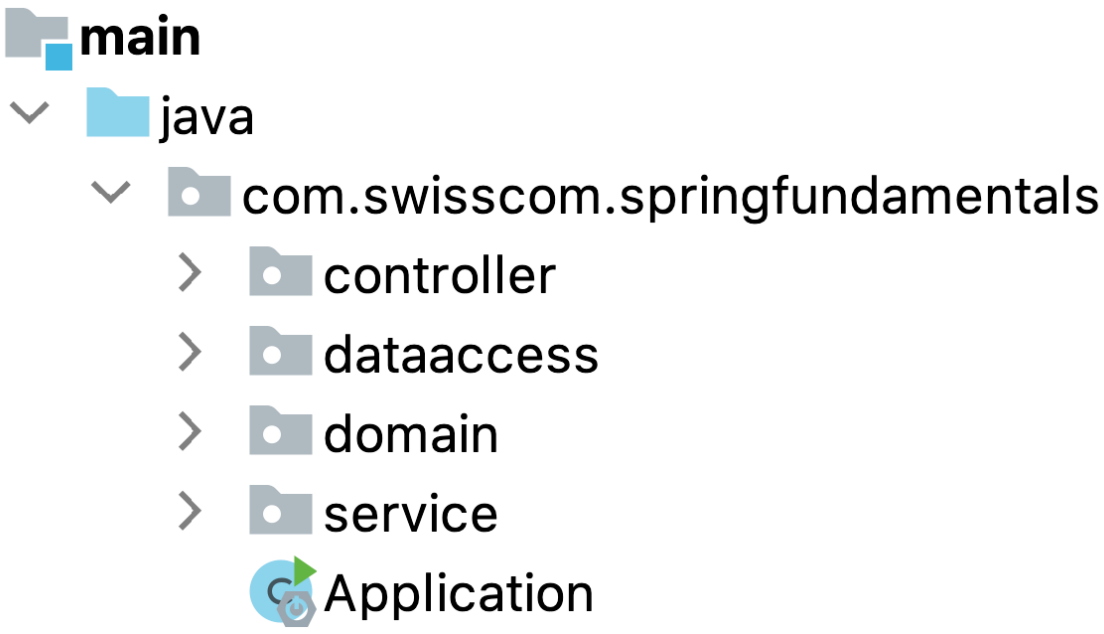
- Spring Boot specific annotation
- Enables the auto configuration of Spring Boot
- See Chapter “Spring Boot - AutoConfiguration”

@SpringBootConfiguration

- Spring Boot specific annotation
- Wraps @Configuration
- It is a bit more convenient than @Configuration: i.e. in spring boot tests the configuration can be found automatically

Spring Boot / Project Structure

- Locate your main application in a root package above other classes.
- Don’t use the default package!



This class should contain the main method as well as the @SpringBootApplication annotation

Spring Boot / and Gradle

Provides Spring Boot support in Gradle, allowing you to package executable jar or war archives and run Spring Boot applications

This version also serves as spring boot version for the dependency management plugin

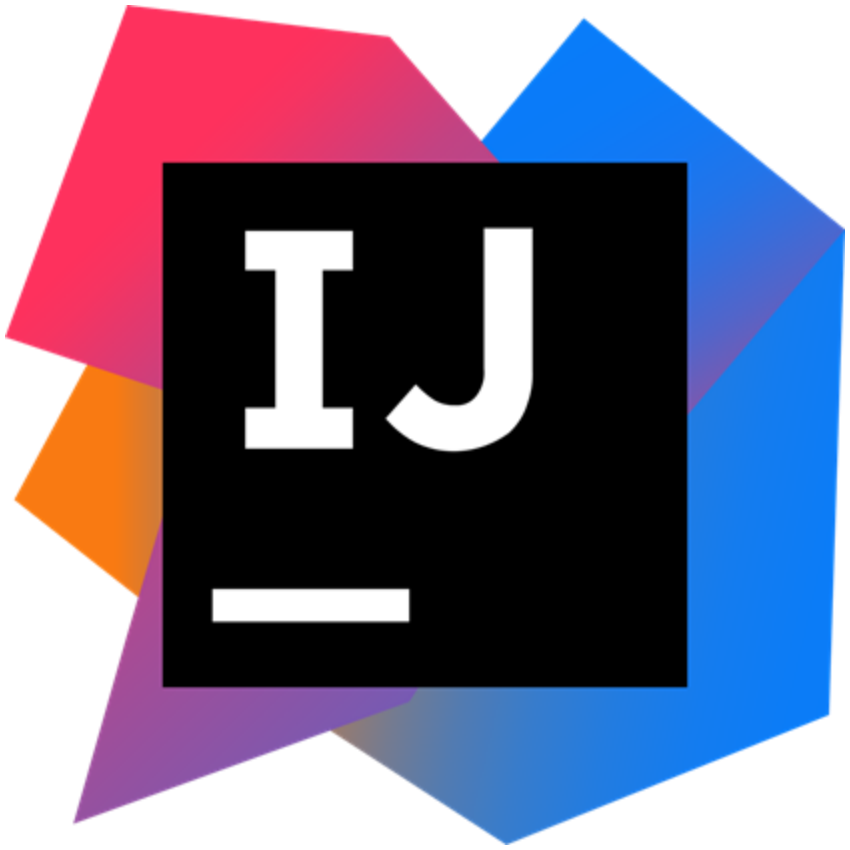
```
plugins { id 'org.springframework.boot' version ‘3.3.3.' }

plugins { id 'io.spring.dependency-management' version ‘1.1.6' }
```

Provides Maven-like dependency management / BOM

BOM?

Spring Boot Dependency BOM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Spring Boot

Starters

“Provide **opinionated** 'starter' dependencies to simplify your build configuration”

(https://spring.io/projects/spring-boot)

...?

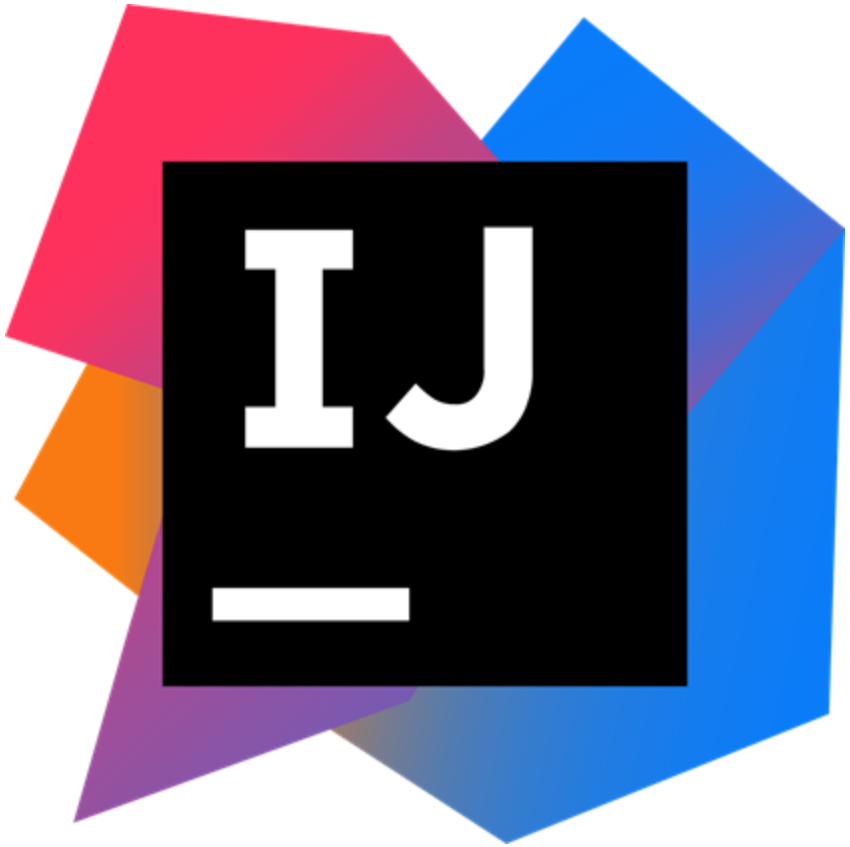
Spring Boot / Starters

```
dependencies {

    implementation 'org.springframework:spring-core:5.1.3.RELEASE'
    implementation 'org.springframework:spring-context:5.1.3.RELEASE'
    implementation 'org.springframework:spring-webmvc:5.1.3.RELEASE'
    implementation 'com.fasterxml.jackson.core:jackson-core:2.9.8'
    implementation 'com.fasterxml.jackson.core:jackson-databind:2.9.8'
    implementation 'com.fasterxml.jackson.datatype:jackson-datatype-jsr310:2.9.8'

    providedCompile 'javax.servlet:javax.servlet-api:4.0.1'
}
```

Do you remember the build.gradle file from the MVC project?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To make a long story short...

Starters are **collections of dependencies** that are compatible with each other and serve a **common purpose**. Starters **should not contain logic or code**.

Be pragmatic!

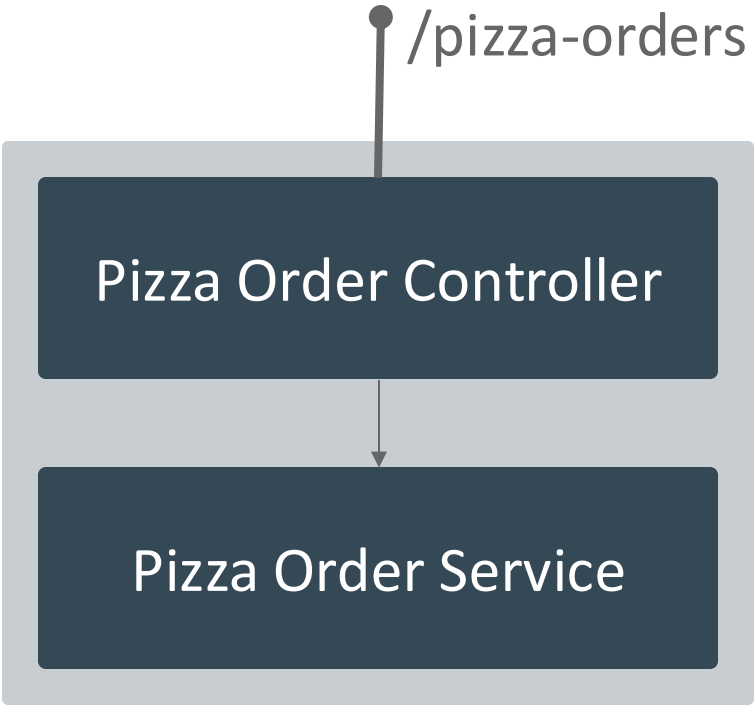
Spring Boot Starter Overview

hands-on

https://github.com/spring-fundamentals/hands-on

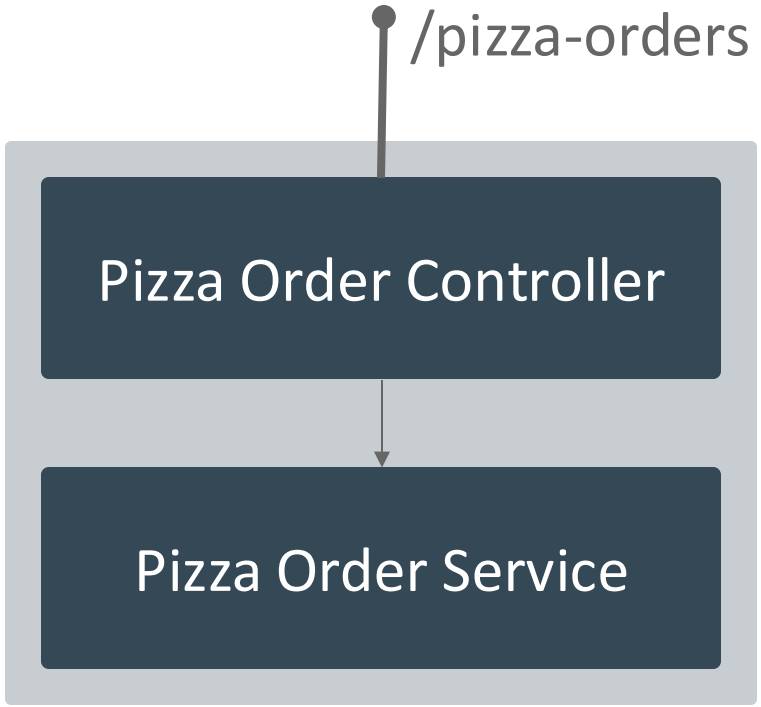
Spring Boot / Hands-On 1

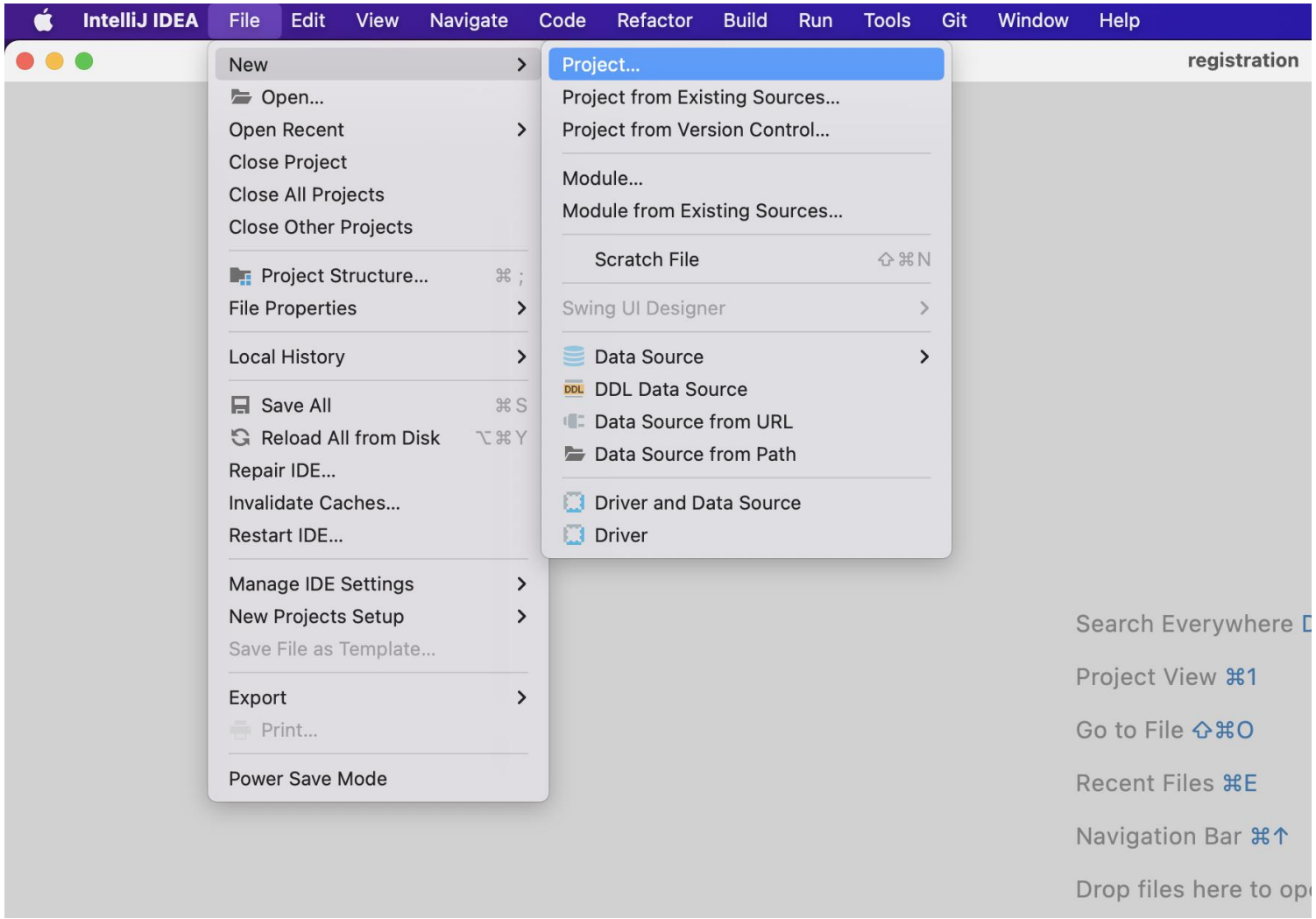
- Create a new Spring Boot application
- The app should have one REST endpoint that returns all pizza-orders (GET).
- A pizza order consists of an ID and a list of order items. An order item has a name (of the pizza) and a quantity.
- The REST controller should inject a service. This service is responsible for generating some random pizza orders (hard-coded).

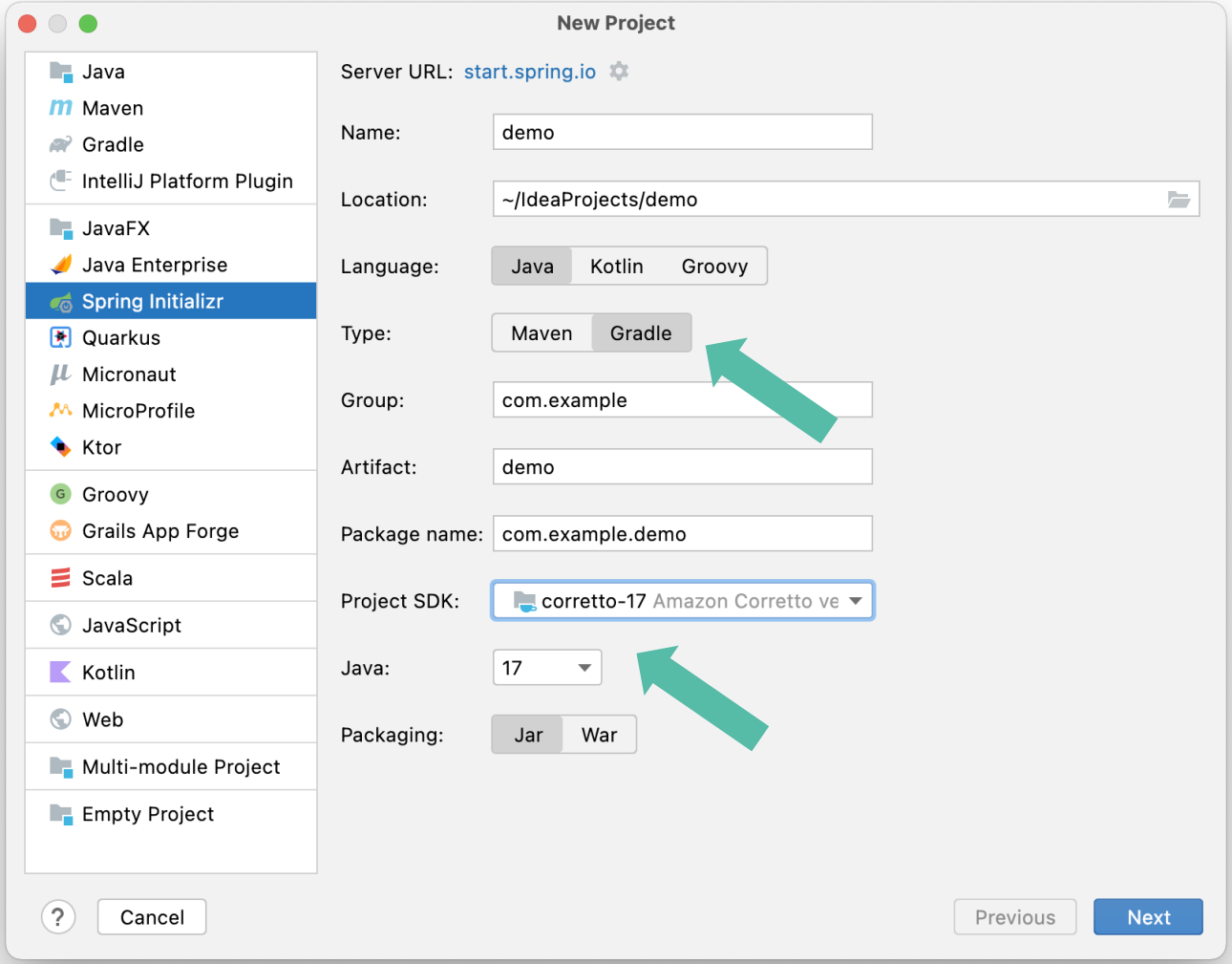


Spring Boot / Hands-On 1

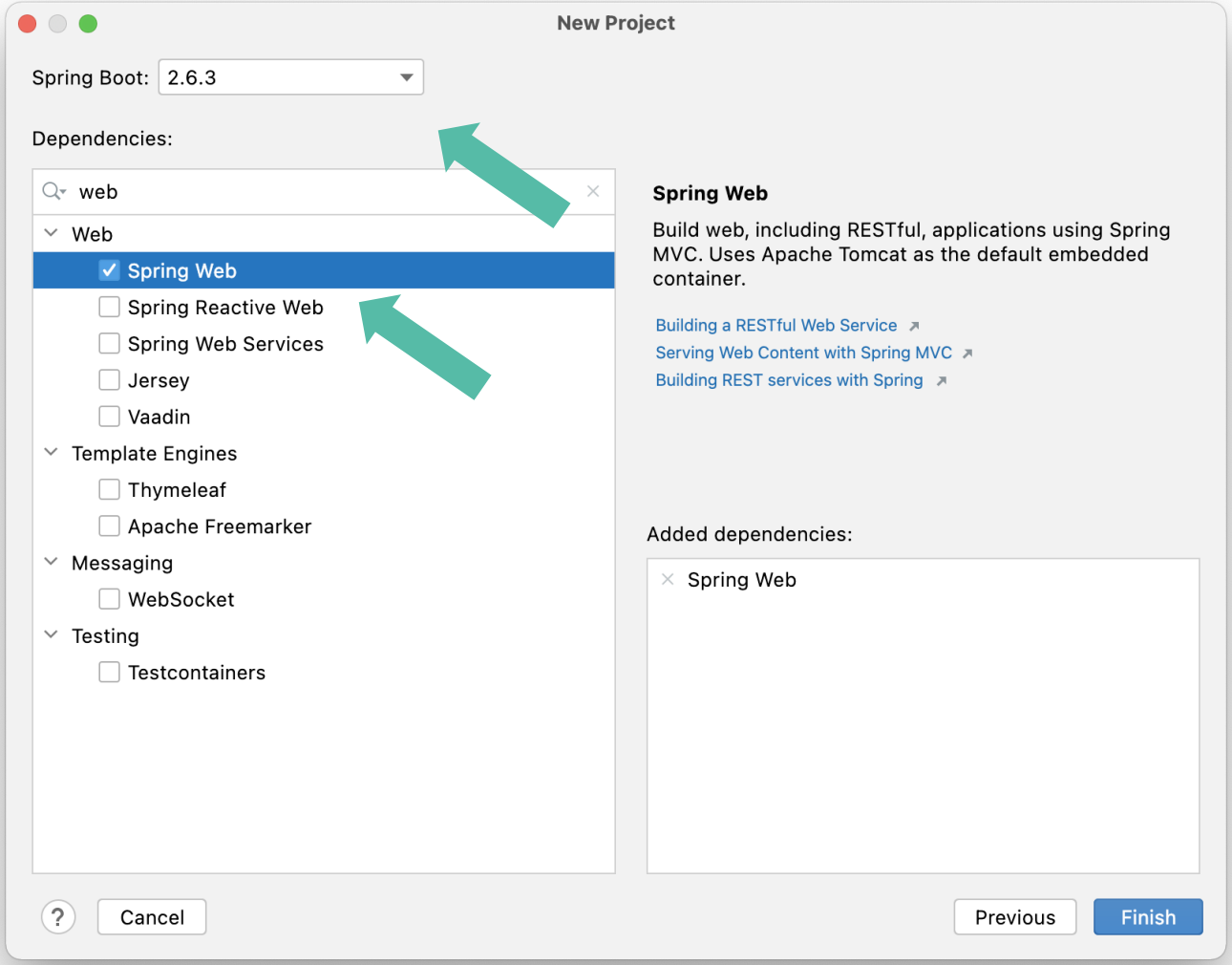
- Add a REST endpoint to get a pizza-order by ID (GET) and throw a IllegalArgumentException if there is no order with this ID.
- Add a REST endpoint (GET) that returns all pizza orders containing a particular pizza (pizzaName as request parameter).
- Add a REST endpoint to create a new pizza-order (POST). You can store the new pizza orders in a list or a map of your choice.



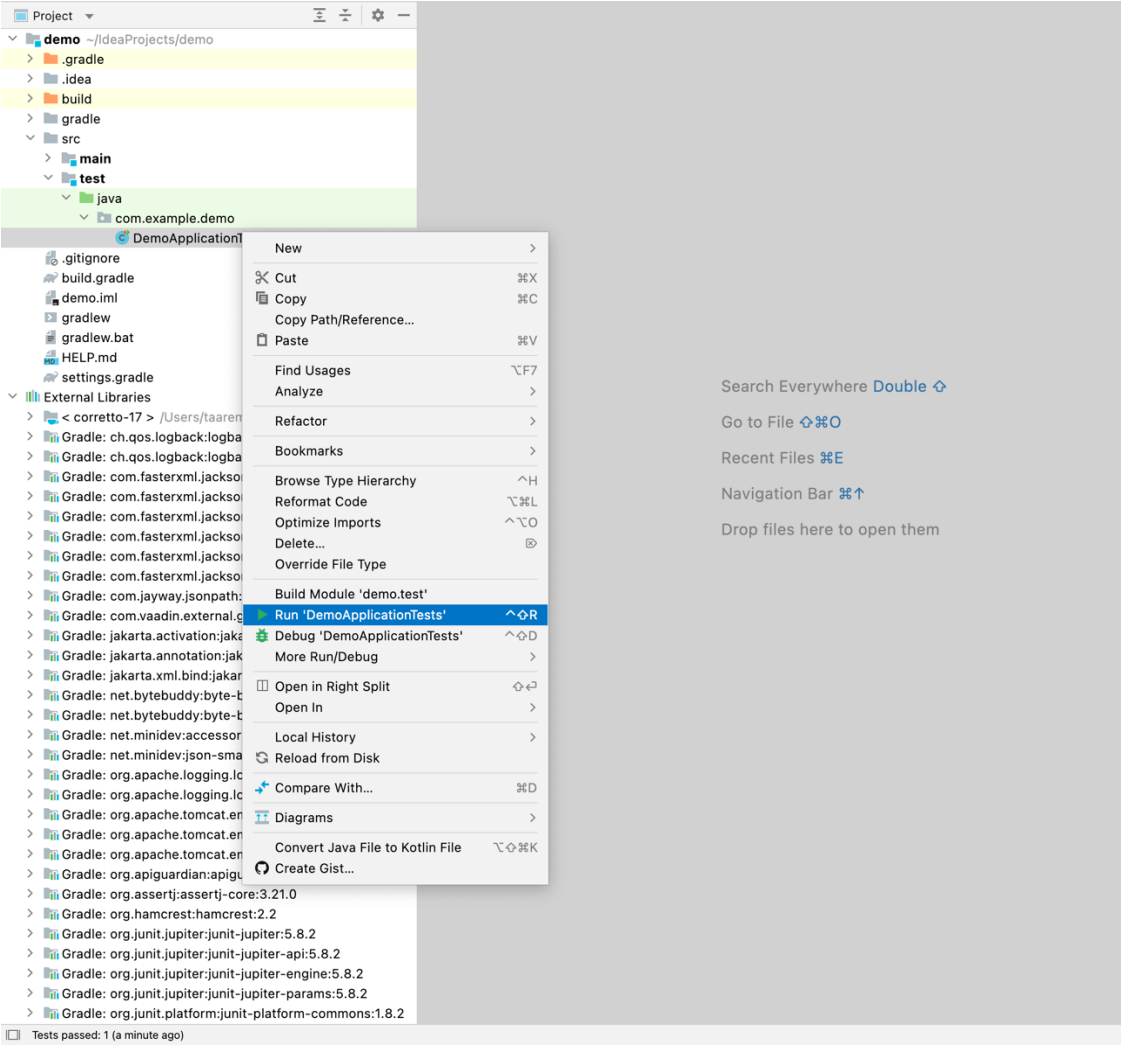

IntelliJ IDEA
File
Edit
View
Navigate
Code
Refactor
Build
Run
Tools
Git
Window
Help
registration
New
Open...
Open Recent
Close Project
Close All Projects
Close Other Projects
Project Structure... ⌘ ;
File Properties
Local History
Save All ⌘S
Reload All from Disk ⌥⌘Y
Repair IDE...
Invalidate Caches...
Restart IDE...
Manage IDE Settings
New Projects Setup
Save File as Template...
Export
Print...
Power Save Mode
Project...
Project from Existing Sources...
Project from Version Control...
Module...
Module from Existing Sources...
Scratch File ⇧⌘N
Swing UI Designer
Data Source
DDL Data Source
Data Source from URL
Data Source from Path
Driver and Data Source
Driver
Search Everywhere
Project View ⌘1
Go to File ⇧⌘O
Recent Files ⌘E
Navigation Bar ⌘↑
Drop files here to op



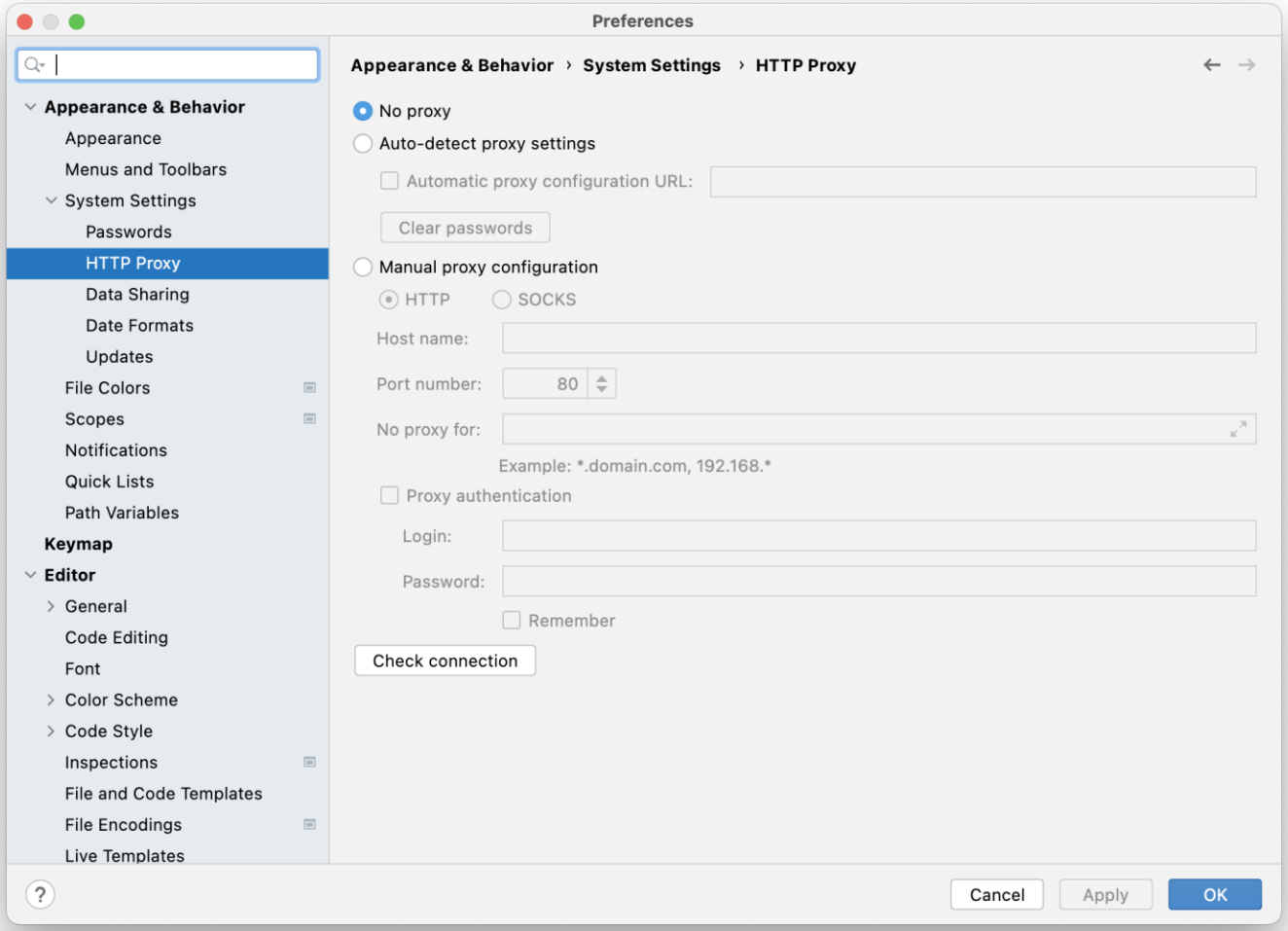
Choose the build tool (Maven or Gradle) and the JDK version of your choice. Neither is important for the course.



Use the pre-selected Spring Boot Version (must not be 2.6.3). Add Spring Web as dependency and click on “Finish”.



To verify your setup, you can simply execute the empty test generated by the initializr.



If you face any issues with proxies, disconnect the VPN connection and select “No proxy” in IntelliJ’s Preferences.

Spring Boot / Hands-On

If you don’t have a REST Client installed, you can use IntelliJ by creating a new “HTTP Request” scratch file (Mac OS: ⇧⌘N, Windows: Ctrl+Shift+Alt+Insert) from which you can start HTTP Requests in the following format:

```
GET http://localhost:8080/customers
```

```
DELETE http://localhost:8080/customers/1
```

```
PUT http://localhost:8080/customers/1
Content-Type: application/json
{
  "name": "ACME Europe"
}
```

```
POST http://localhost:8080/customers
Content-Type: application/json
{
  "name": "ACME Europe"
}
```

How much ”Spring Boot" did you do during the exercise?

Spring Boot

Auto Configuration

Spring Boot / Auto Configuration

"Spring embraces flexibility and is **not opinionated** about how things should be done. It supports a wide range of application needs with different perspectives."

(https://docs.spring.io/spring/docs/5.1.3.RELEASE/spring-framework-reference/overview.html#overview-philosophy)

Do you remember this?

Spring Framework

"We take an **opinionated** view of the Spring platform and third-party libraries, so that you can get started with minimum fuss." (https://docs.spring.io/spring-boot/docs/current/reference/htmlsingle/#getting-started-introducing-spring-boot)

Spring Boot

Spring Boot / Auto Configuration

And do you remember this configuration class?

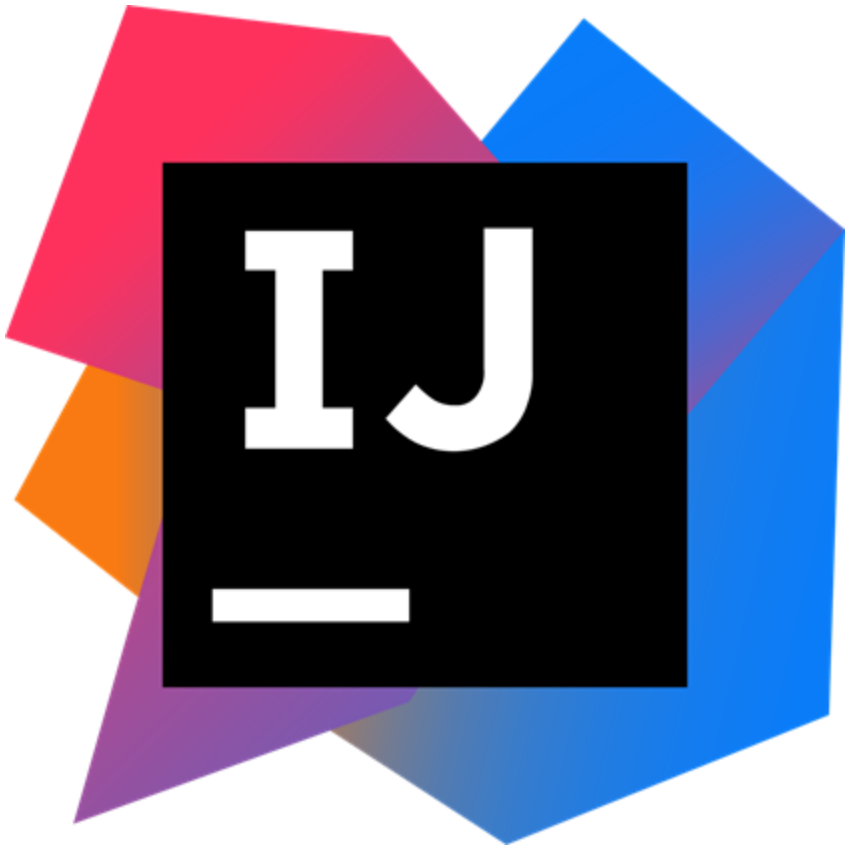
```
@Configuration
@EnableWebMvc
public class AppConfig implements WebMvcConfigurer {
    @Override
    public void configureDefaultServletHandling(DefaultServletHandlerConfigurer configurer) {
        configurer.enable();
    }

    @Override
    public void configureMessageConverters(List<HttpMessageConverter<?>> converters) {
        Jackson2ObjectMapperBuilder builder = new Jackson2ObjectMapperBuilder();
        builder.indentOutput(true).dateFormat(new SimpleDateFormat("yyyy-MM-dd"));
        converters.add(new MappingJackson2HttpMessageConverter(builder.build()));
    }
}
```

So we can summarize…

- Spring Framework offers a lot of freedom.
- But in many applications, we have to configure exactly the same things with exactly the same settings.
- And for all these configurations we have approximately an infinite number of possibilities to do so.

And this is where the auto configuration of Spring Boot comes in.

Let’s start our application with enabled debug output.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Spring Boot / Auto Configuration

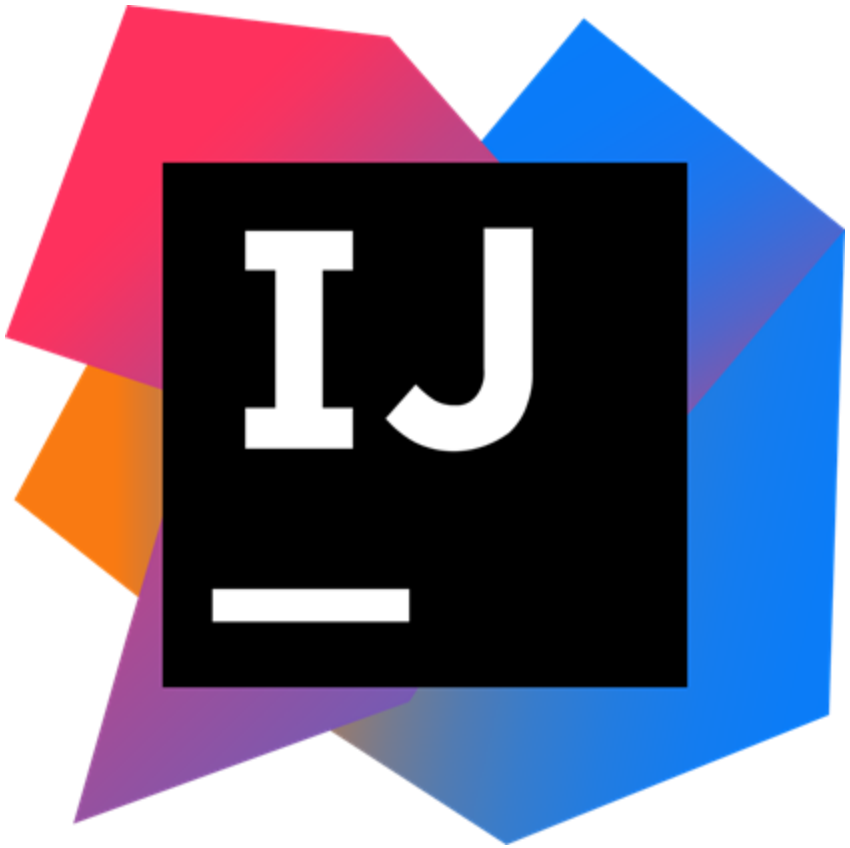
```
JmsAutoConfiguration:
      Did not match:
          - @ConditionalOnClass did not find required class
            'javax.jms.Message' (OnClassCondition)
```

Spring Boot / Auto Configuration

```
JacksonAutoConfiguration matched:
        - @ConditionalOnClass found required class
            'com.fasterxml.jackson.databind.ObjectMapper’
            (OnClassCondition)
```

But where are all these conditions and configurations are from?

Let’s have a look in to the spring-boot-autoconfigure dependency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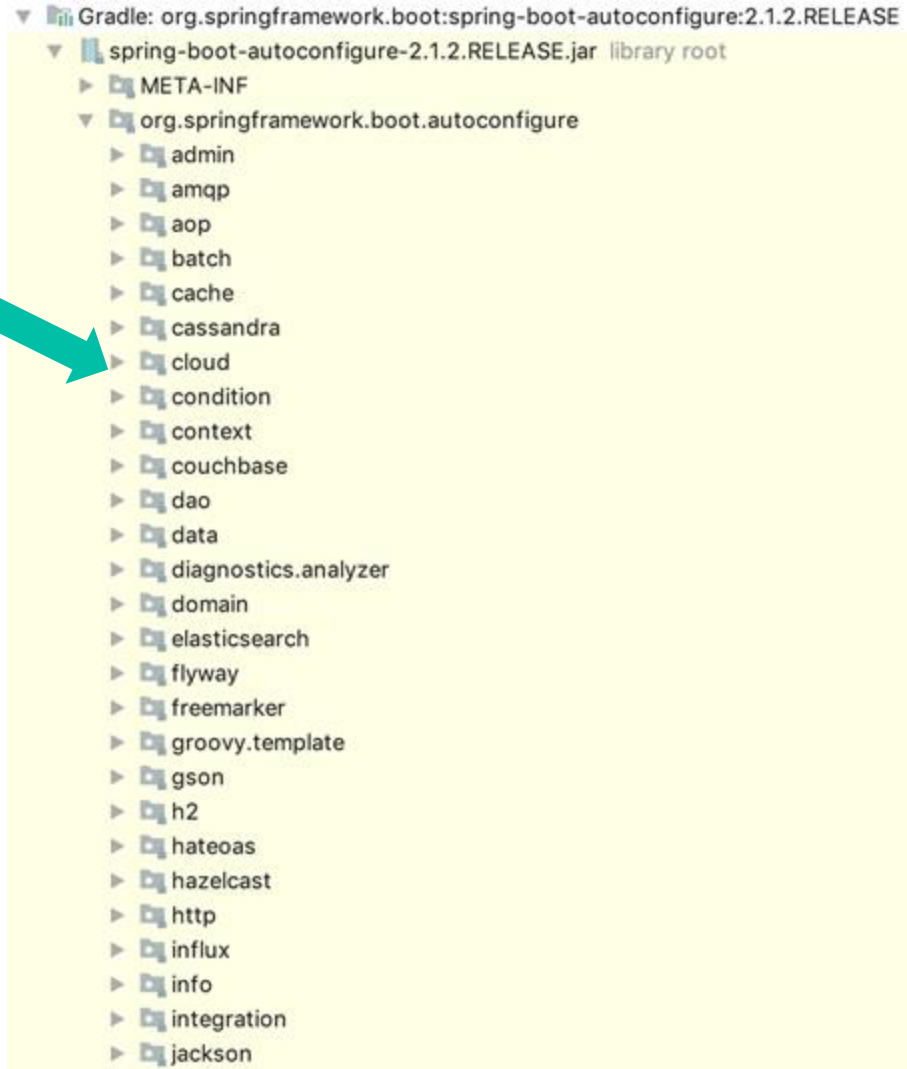
Spring Boot / Auto Configuration

In addition, there is package that contains further annotations that are based on the @Conditional approach, that we discussed in the basic chapter.

There is a whole bunch of configuration classes for various frameworks. These classes are more or less reflecting the opinionated view on the Spring framework.



And how does Spring know that it should consider all these @Configuration classes during context initialization?

Spring Boot / Auto Configuration

Gradle: org.springframework.boot:spring-boot-autoconfigure:3.1.3
- spring-boot-autoconfigure-3.1.3.jar library root
  - META-INF
    - spring
      - aot.factories
      - org.springframework.boot.autoconfigure.AutoConfiguration.imports
    - additional-spring-configuration-metadata.json
    - LICENSE.txt
    - MANIFEST.MF
    - NOTICE.txt
    - spring.factories
    - spring-autoconfigure-metadata.properties
    - spring-configuration-metadata.json
  - org.springframework.boot.autoconfigure

Spring checks for the presence of META-INF/spring/ org.springframework.boot.autoconfigure.AutoConfiguration.imports files in your classpath.

Yes, you can create your own dependencies with such a file in the META-INF folder, where you can define configuration classes that should be auto-configured.

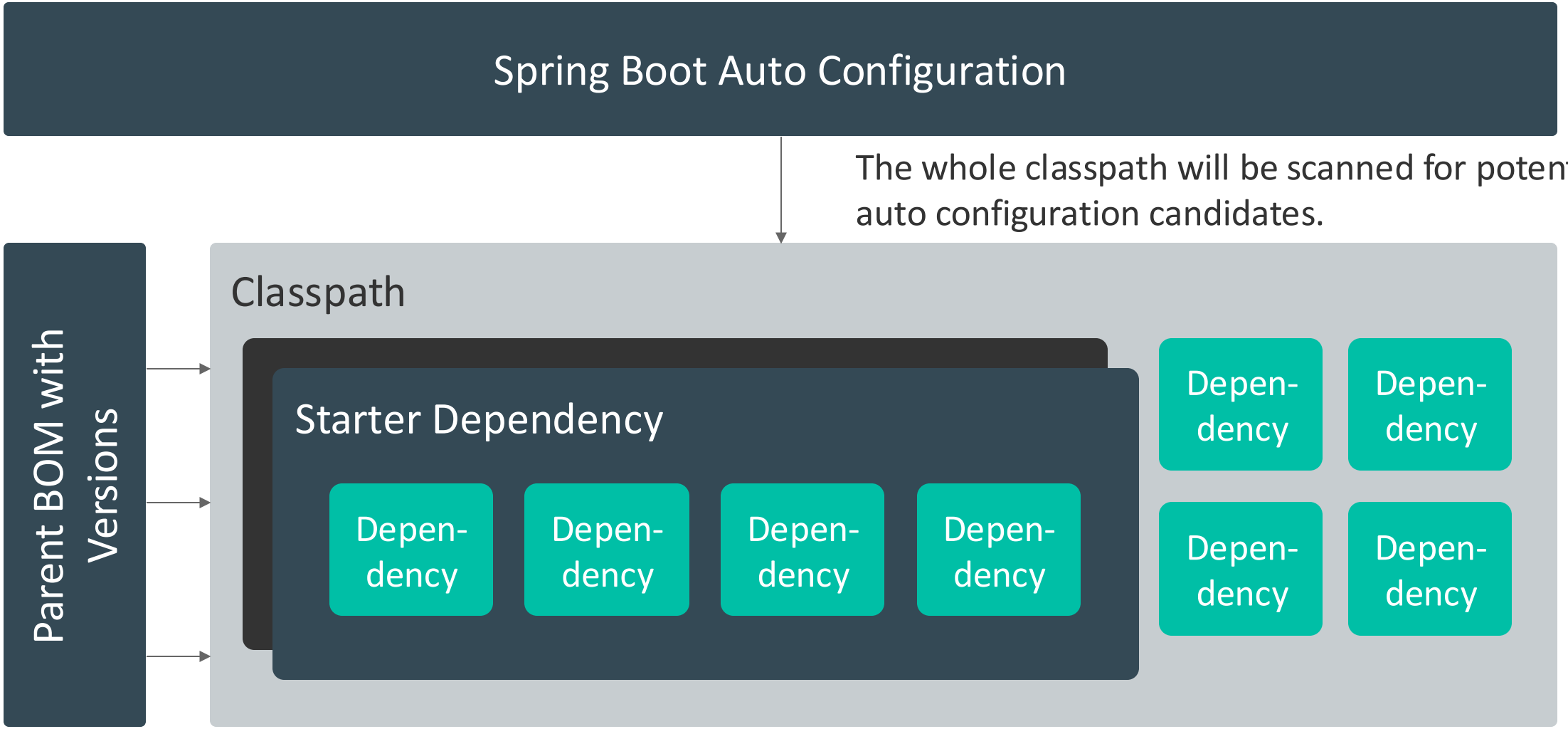
Spring Boot / Auto Configuration

And in this file, there is one section with a whole bunch of configuration classes. All these classes will be considered and their conditions will be evaluated during context initialization

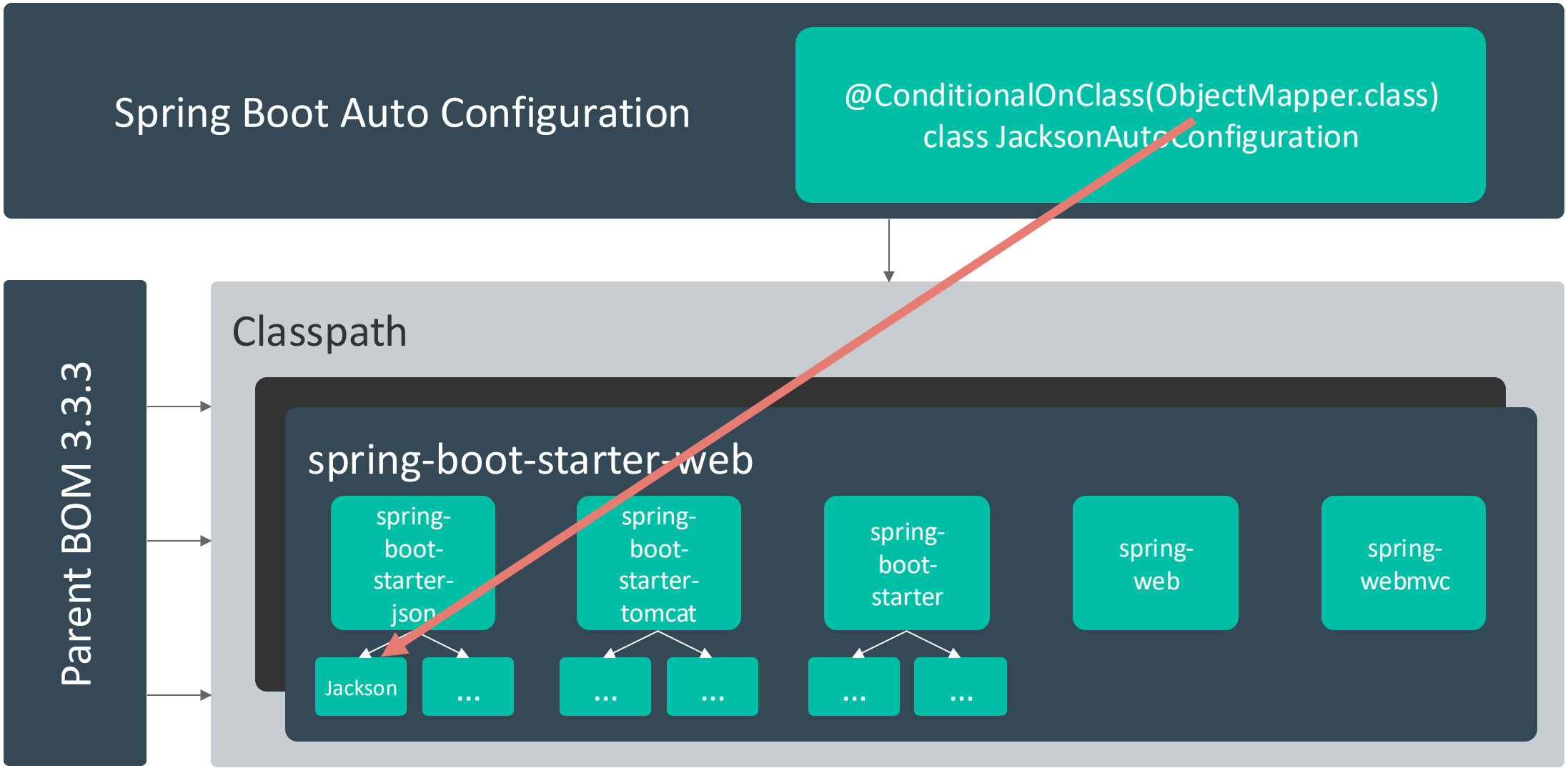
```
# Auto Configure
org.springframework.boot.autoconfigure.admin.SpringApplicationAdminJmxAutoConfiguration
org.springframework.boot.autoconfigure.aop.AopAutoConfiguration
...
org.springframework.boot.autoconfigure.data.elasticsearch.ElasticsearchAutoConfiguration
org.springframework.boot.autoconfigure.flyway.FlywayAutoConfiguration
...
org.springframework.boot.autoconfigure.gson.GsonAutoConfiguration
…
org.springframework.boot.autoconfigure.jackson.JacksonAutoConfiguration
...
org.springframework.boot.autoconfigure.jms.JmsAutoConfiguration
```

Starters
vs.
Auto Configuration

Spring Boot / Auto Configuration



Spring Boot / Auto Configuration



Starters and auto configuration are decoupled mechanisms,
but in combination they are pretty elegant.

Spring Boot “Magic”

=

BOM + Starters + Auto Configuration

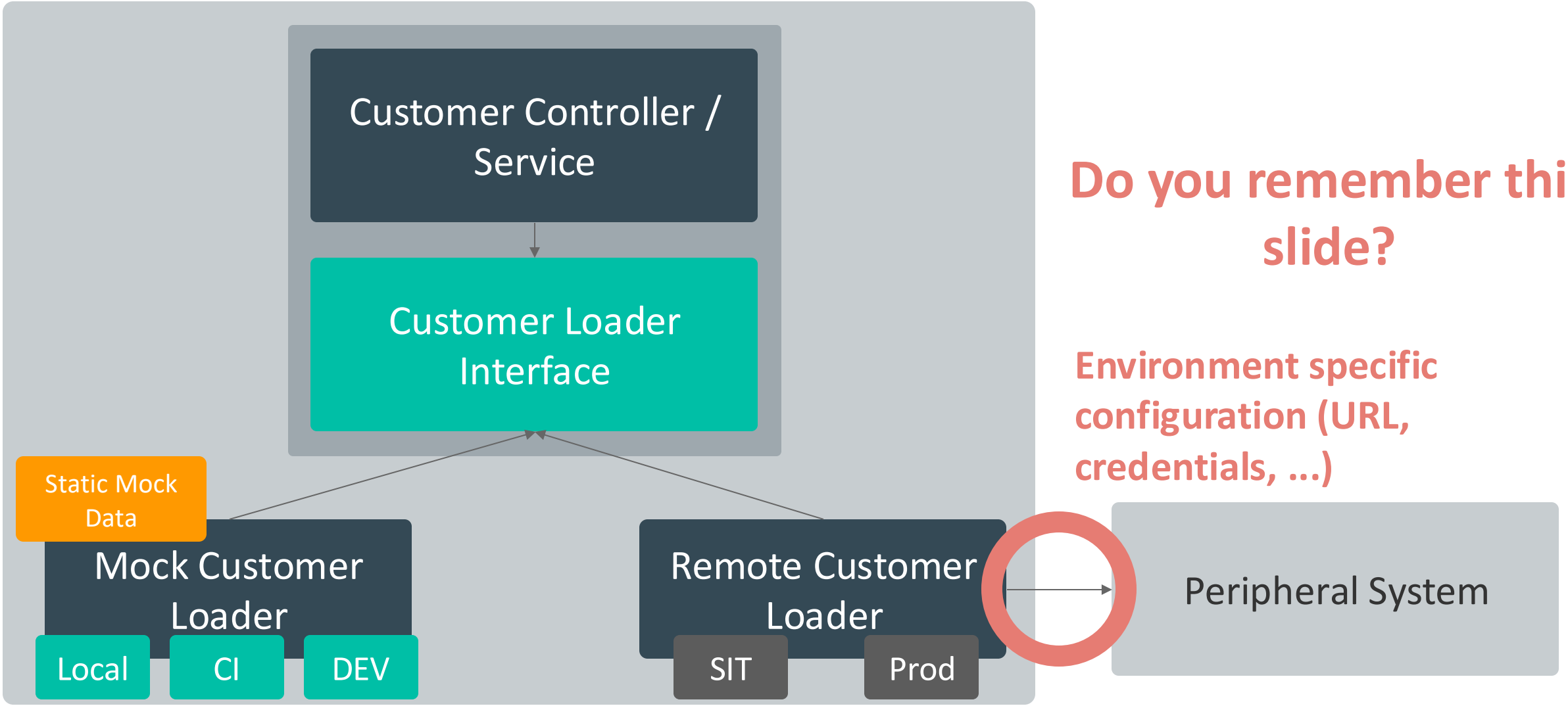
Spring Boot

Profiles, Properties and Externalized Configuration

Spring Boot / Profiles, Properties and Externalized Configuration

"Spring Boot lets you **externalize your configuration** so that you can work with the **same application** code in **different environments**."

Spring Boot / Profiles, Properties and Externalized Configuration



Do you remember this slide?

Environment specific configuration (URL, credentials, ...)

But where can I define these externalized configuration things?

Spring Boot / Profiles, Properties and Externalized Configuration

1. Devtools global settings properties on your home directory (`~/.spring-boot-devtools.properties` when devtools is active).
2. `@TestPropertySource` annotations on your tests.
3. `properties` attribute on your tests. Available on `@SpringBootTest` and the test annotations for testing a particular slice of your application.
4. Command line arguments.
5. Properties from `SPRING_APPLICATION_JSON` (inline JSON embedded in an environment variable or system property).
6. `ServletConfig` init parameters.
7. `ServletContext` init parameters.
8. JNDI attributes from `java:comp/env`.
9. Java System properties (`System.getProperties()`).
10. OS environment variables.
11. A `RandomValuePropertySource` that has properties only in `random.*`.
12. Profile-specific application properties outside of your packaged jar (`application-{profile}.properties` and YAML variants).
13. Profile-specific application properties packaged inside your jar (`application-{profile}.properties` and YAML variants).
14. Application properties outside of your packaged jar (`application.properties` and YAML variants).
15. Application properties packaged inside your jar (`application.properties` and YAML variants).
16. `@PropertySource` annotations on your `@Configuration` classes.
17. Default properties (specified by setting `SpringApplication.setDefaultProperties`).

Spring Boot consider property sources in the following order

We will have a closer look into these property sources

.properties

vs

.yml

Spring Boot / Profiles, Properties and Externalized Configuration

```
pizza.inventory.mock=false
pizza.inventory.url=https://api.pizza-inventory.com
pizza.inventory.user=admin
pizza.inventory.password=tester11
```

.properties

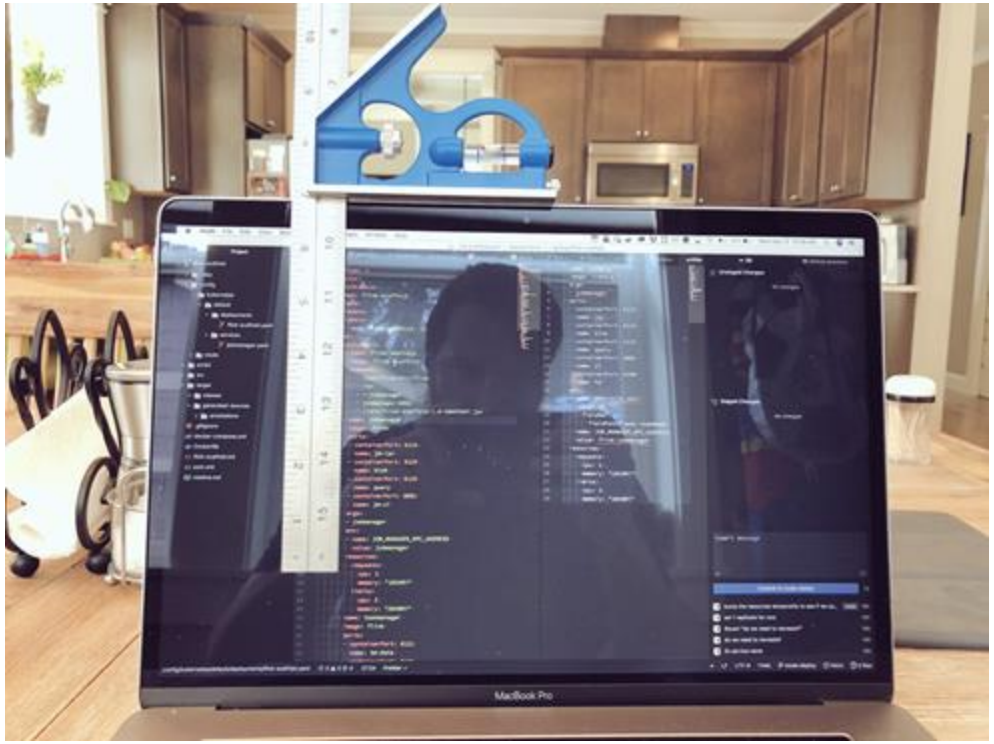
```yaml
pizza:
  inventory:
    mock: false
    url: https://api.pizza-inventory.com
    user: admin
    password: tester11
```

.yml

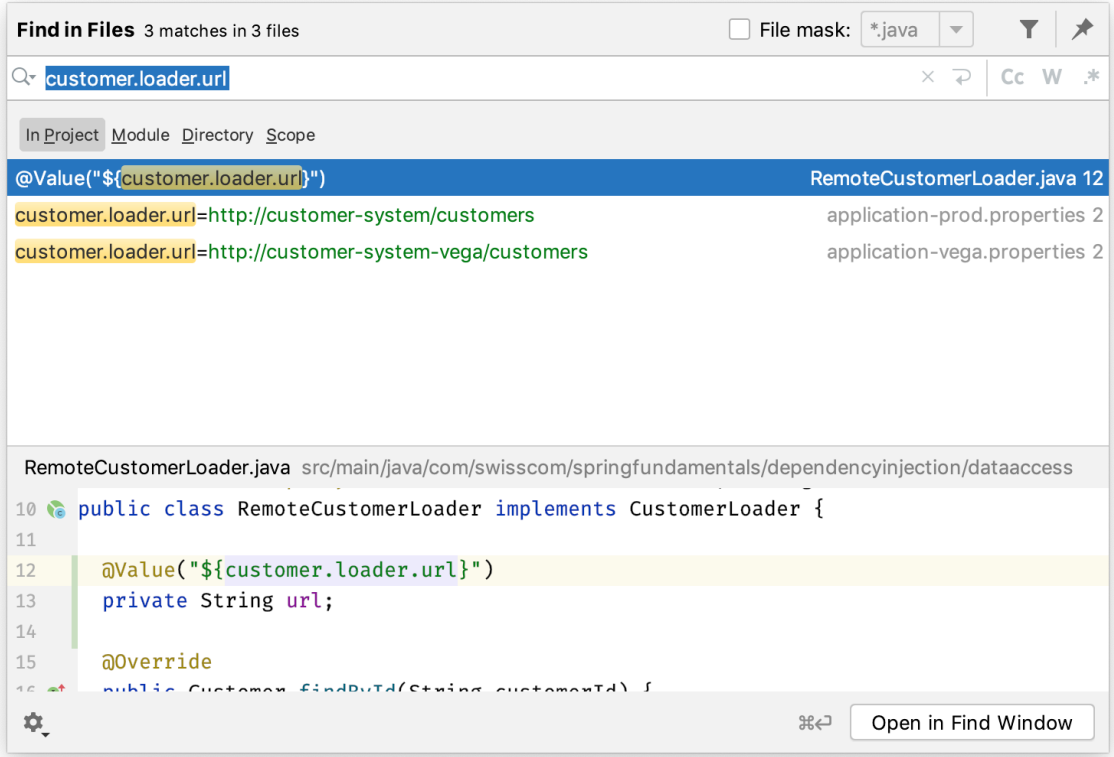
And what should I use?

.properties!

Spring Boot / Profiles, Properties and Externalized Configuration



YAML files doesn’t provide a good UX



You can search for properties in .properties files

Spring Boot / Profiles, Properties and Externalized Configuration

application.properties

Examples: App information like name, context or port.

The properties in **application.properties** file are loaded independently of the active profile. However, the properties can be overwritten in the profile specific files (see property source order).

profile name

application-prod.properties

Examples: Url and credentials from peripheral systems.

If there are explicitly activated profiles, then properties from **application-{profile}.properties** are loaded.

application-default.properties

No specific usage. Default can be used as local profile.

If no profiles are explicitly activated, then properties from **application-default.properties** are loaded.

Spring Boot / Profiles, Properties and Externalized Configuration

All **application.properties** and **application-{profile}.properties** files should be saved to **src/main/resources**. Spring Boot will find them there automatically.

Spring Boot / Profiles, Properties and Externalized Configuration

Property values (independently from the property source) can be injected directly into your beans by using the `@Value` annotation.

Spring Boot / Profiles, Properties and Externalized Configuration

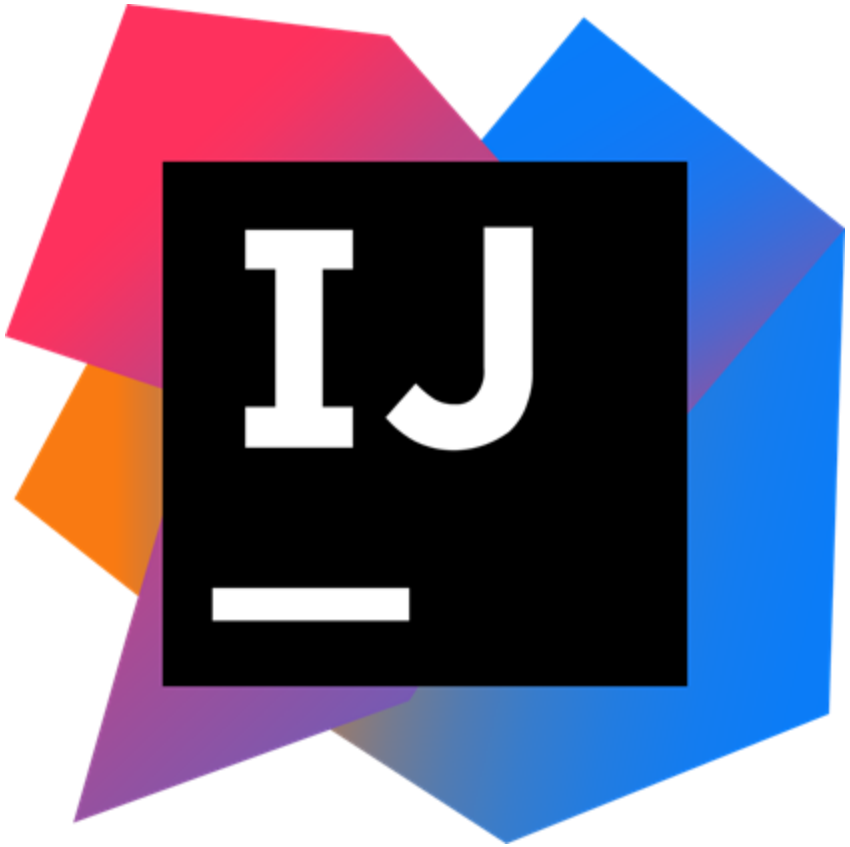
```
@Service
public class PizzaInventoryService {

    @Value("${pizza.inventory.url}")
    private String url;

    @Value("${pizza.inventory.user}")
    private String user;

    @Value("${pizza.inventory.password}")
    private String password;
}
```

Field injection with @Value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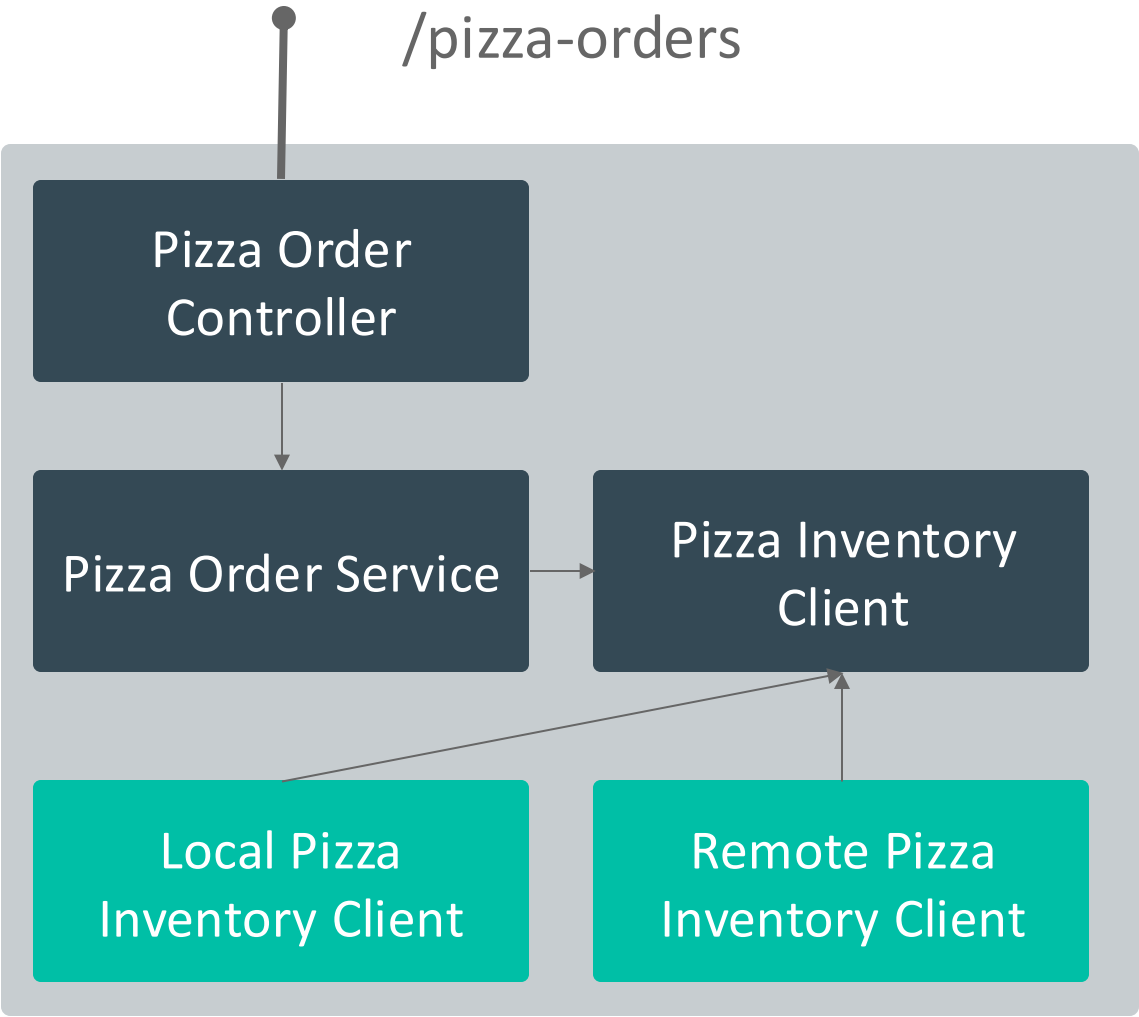
hands-on

https://github.com/spring-fundamentals/hands-on

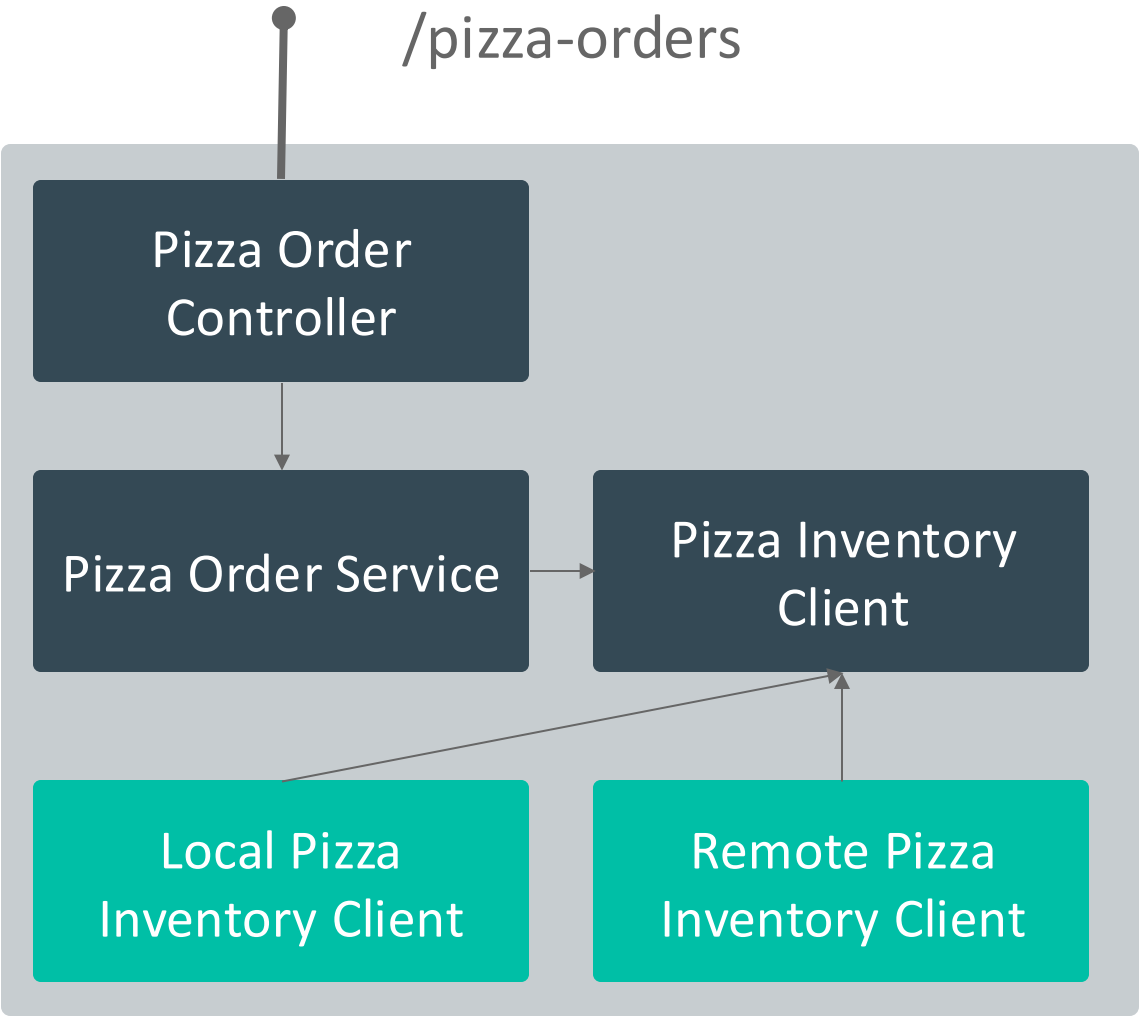
Spring Boot / Hands-On 2

- Introduce a new interface “Pizza Inventory Client” with two implementations Local- and Remote Pizza Inventory Client. Find a mechanism to load them conditionally.
- The pizza inventory client has one method *boolean isAvailable(String pizzaName)*
- The local implementation always returns true
- The remote implementation should return randomly true or false.



Spring Boot / Hands-On 2

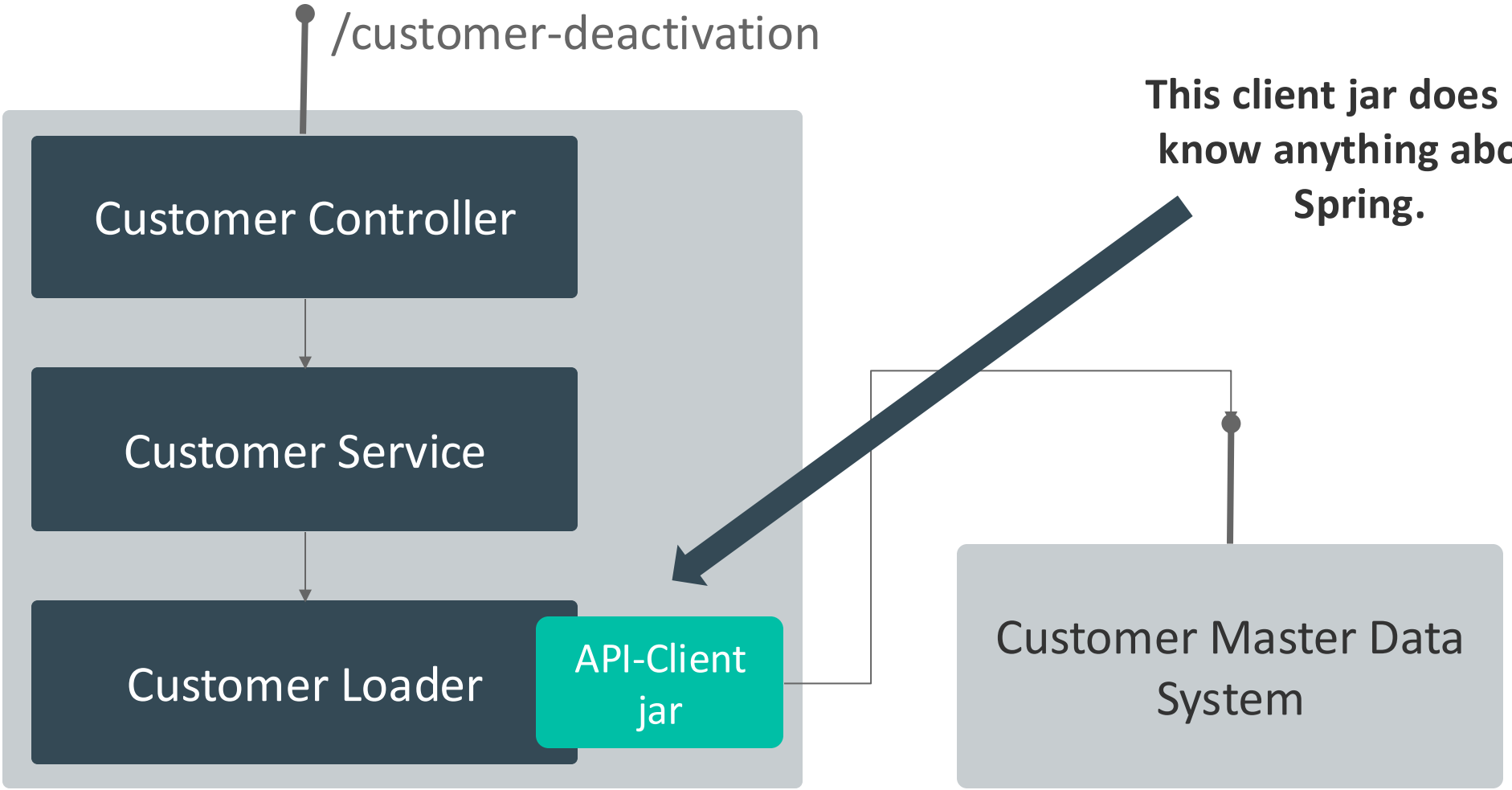
- The pizza order service should inject the new pizza inventory client and in case of a new pizza order it should call the isAvailable method for each ordered pizza.



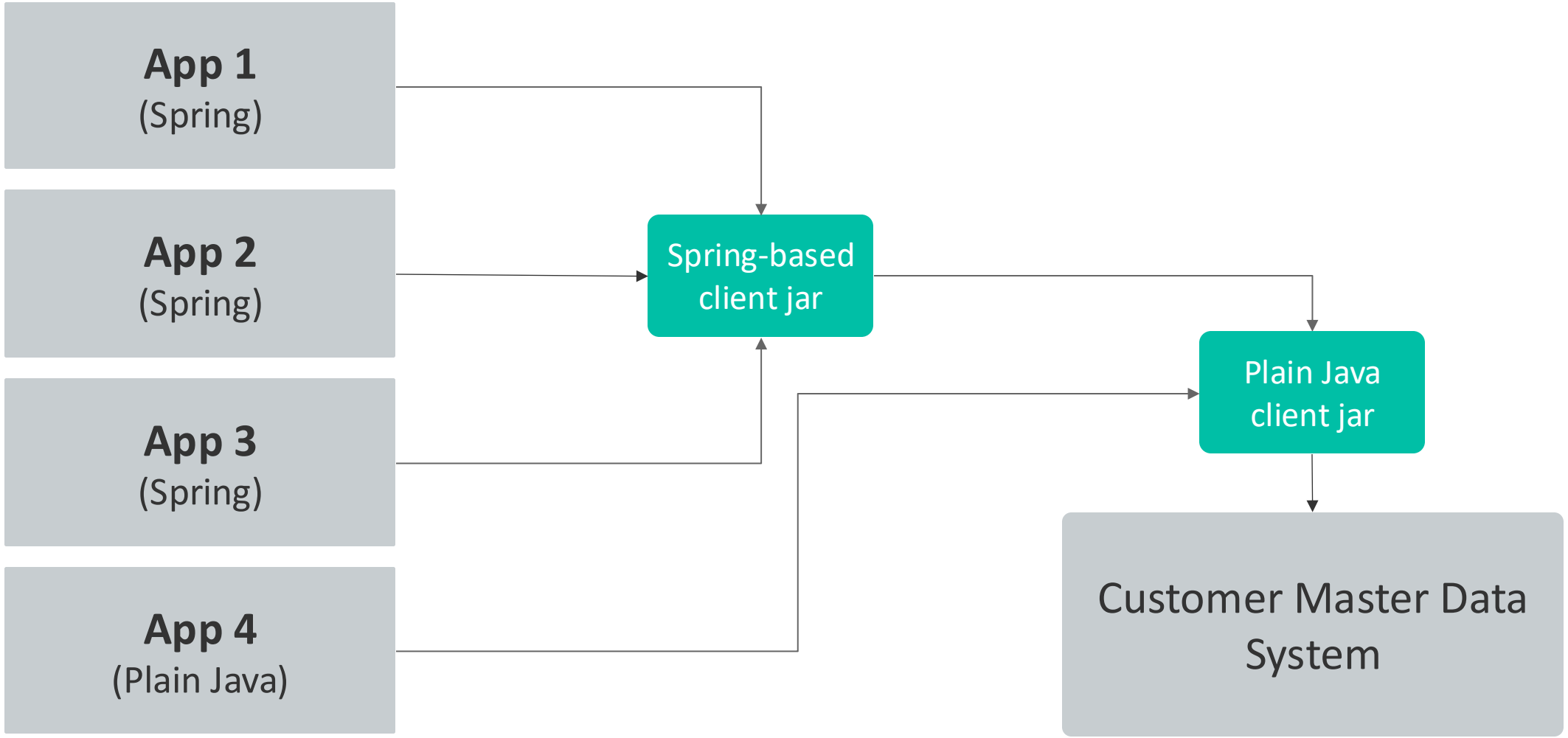
Spring Boot

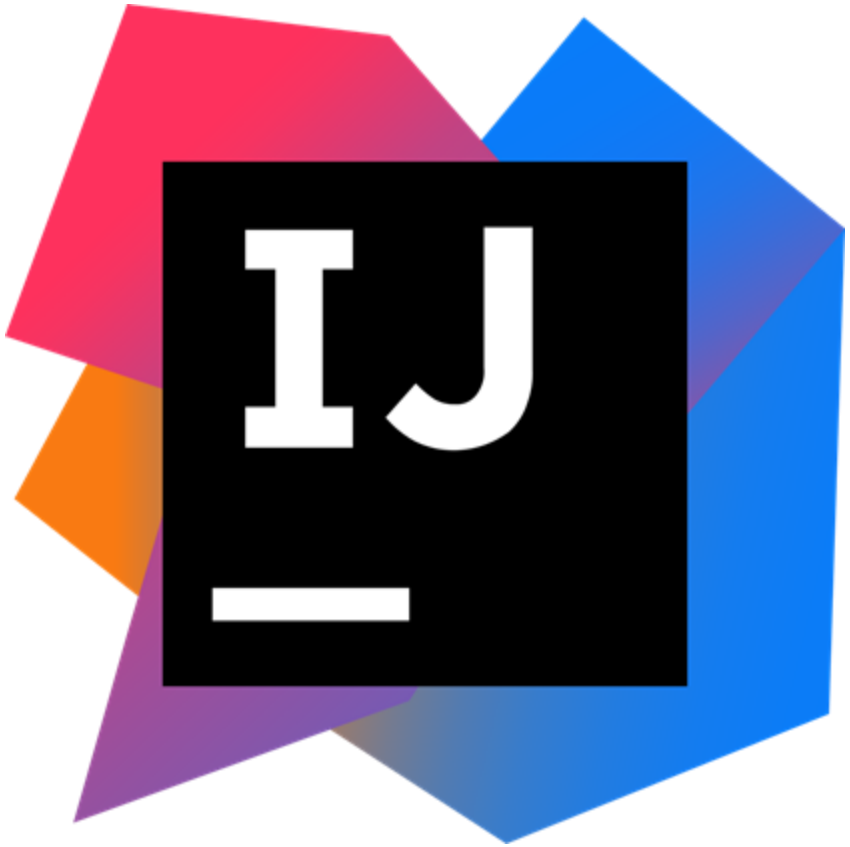
(Auto) Configuration Sample

Spring Boot / Auto Configuration Sample



Spring Boot / Auto Configuration Sample

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Spring Boot

Wrap-up

Spring Boot / Wrap-Up

- Put your @SpringBootApplication in your Top-Level package
- Don’t use the default package
- If you have a common problem, there will be a solution for Spring (Boot). So check it out before building your own proprietary solution.
- It is helpful to understand at least the basics of Spring Boot Auto Configuration, because sometimes it really looks like magic (but it’s not).
- Use Property files instead of yaml files.
- Use Starters
- Consider Actuator and DevTools

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Wrap-up

Wrap-up / And why should I use Spring?

- Good and well-proven practices
- Huge ecosystem
- Good testing support
- No proprietary self-made solutions
- Easy knowledge transfer
- Easier to find new developers

Wrap-up / Resources

https://github.com/spring-fundamentals

Wrap-up / Further Links

- https://docs.spring.io/spring-boot/docs/current/reference/html/executable-jar.html
- https://www.baeldung.com/spring-web-contexts
- http://www.baeldung.com/integration-testing-in-spring
- https://docs.spring.io/spring-boot/docs/current/reference/html/boot-features-testing.html
- http://www.baeldung.com/spring-boot-testing
- https://docs.spring.io/spring-boot/docs/current/reference/html/boot-features-external-config.html#boot-features-external-config
- https://docs.developer.swisscom.com/buildpacks/java/getting-started-deploying-apps/gsg-spring.html
- https://docs.developer.swisscom.com/buildpacks/java/configuring-service-connections/spring-service-bindings.htm
- https://spring.io/blog/2015/04/27/binding-to-data-services-with-spring-boot-in-cloud-foundryl

Baeldung is a great source for various Spring topics.

Wrap-up / Further Links

- https://www.innoq.com/de/articles/2018/02/ddd-und-tdd-mit-spring-boot-2/#gezieltetestestechnischerschichten
- https://www.webjars.org/
- https://www.baeldung.com/spring-boot-jasypt
- https://docs.spring.io/spring/docs/5.1.3.RELEASE/spring-framework-reference/core.html#spring-core
- https://docs.spring.io/spring-boot/docs/current/reference/htmlsingle/#boot-documentation

A pretty good summary of the concepts of Spring and Spring Boot is provided by the Spring and Spring Boot docs itself (but I do not recommend it for learning Spring from scratch)

Wrap-up / Good Spring Talks

- Building better monoliths – Implementing modulithic applications with Spring by Oliver Gierke
  https://youtu.be/0Sw4EthrT9E

- REST beyond the obvious API design for ever evolving systems by Oliver Gierke
  https://youtu.be/x_9OJKAv-ic

- Bootiful Testing by Josh Long
  https://youtu.be/1W5_tOiwEAc

- Getting started with Spring Cloud by Josh Long
  https://youtu.be/SFDYdslOvu8

- Spring Boot - Behind the curtains: Autoconfiguration
  https://youtu.be/Ybfo8Dwactg

Wrap-up / Good Spring Talks

- Reactive Spring by Josh Long
  https://youtu.be/zVNIZXf4BG8
- Consuming Data Services with Spring Apps on Cloud Foundry - Scott Frederick
  https://youtu.be/g3DbtW5lwqY
- Testing Spring Boot Applications - Phil Webb
  https://youtu.be/QjaoAWLlGGs
- Talks4Nerds: Oliver Gierke - Cloud Native Applications
  https://youtu.be/sjSxOdV84gM
- Talks4Nerds: Oliver Gierke - Spring Framework und Spring Boot 2.0
  https://youtu.be/aTIY_RjTUv0

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Make it a 10