

# Spring Framework Spring Boot Test-Driven Development





Somkiat Puisungnoen

Somkiat Puisungnoen

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Intro

Software Craftsmanship

Software Practitioner at สยามชัมนาณกิจ พ.ศ. 2556

Agile Practitioner and Technical at SPRINT3r

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**[https://github.com/up1/  
course-springboot-2020](https://github.com/up1/course-springboot-2020)**



# Agenda



# Spring Framework

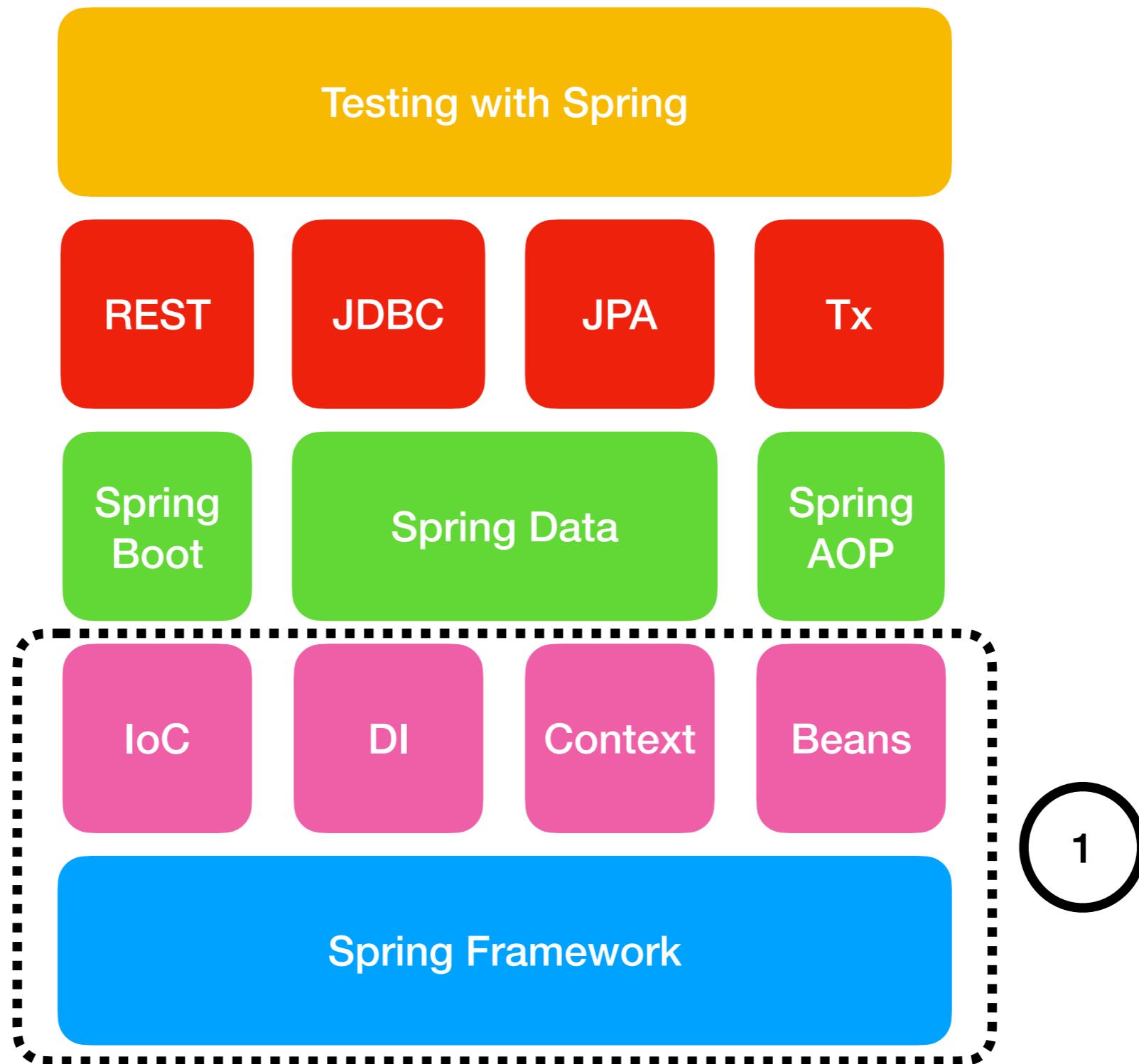


# Agenda

Introduction to Spring framework  
Dependency Injection (DI)  
Inversion of Control (IoC)  
Spring Context and Bean  
How to build project with Spring ?  
Spring Configuration  
Why we need Spring framework ?  
Spring Modules and Project  
SOLID for Object-Oriented Design



# Workshop



# Spring Boot



# Agenda

REST (REpresentational State Transfer)

Introduction to Spring Boot

Goals of Spring Boot

Better project structure of Spring Boot

Develop RESTful APIs

Error handling

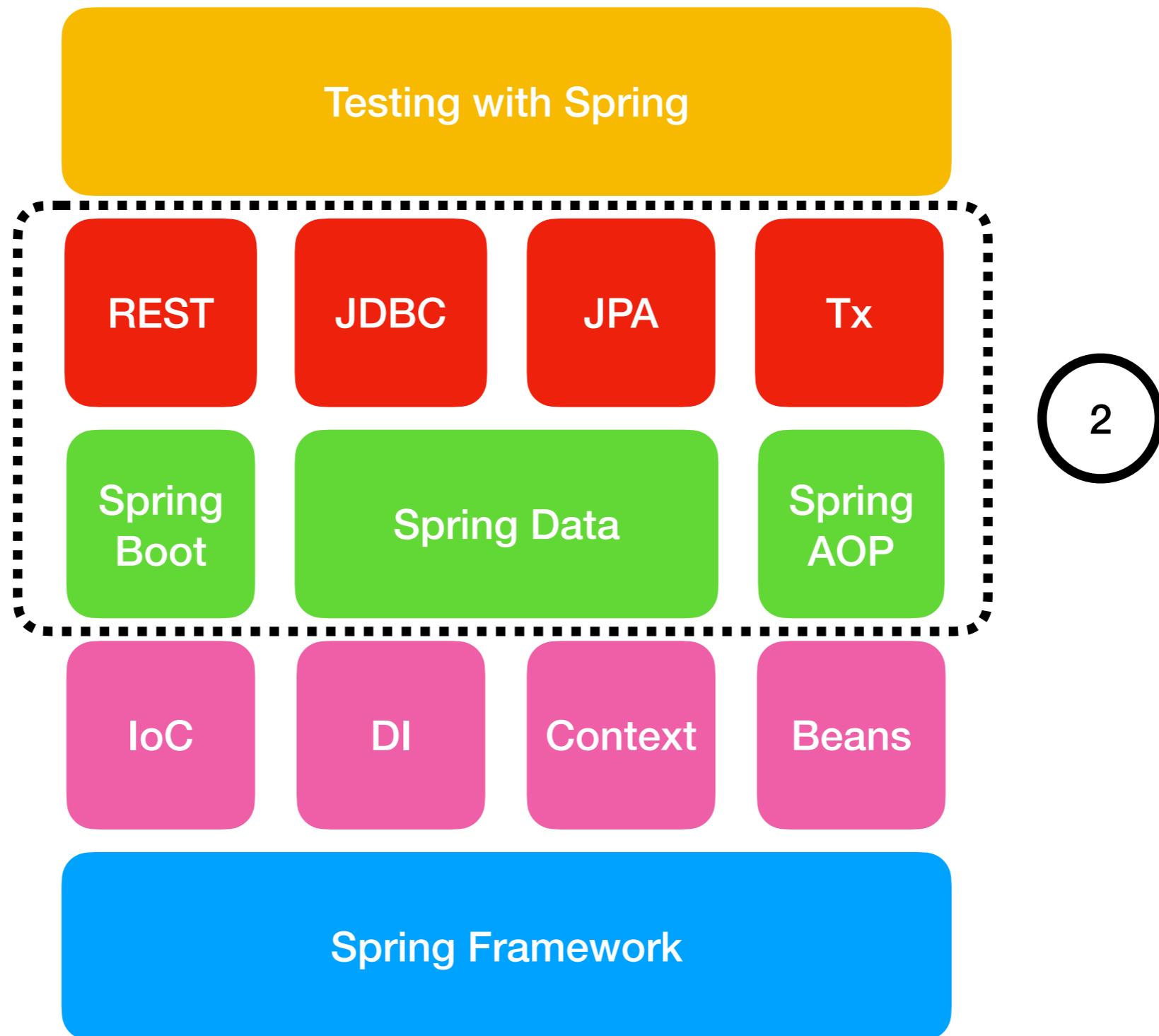
Layer in Spring Boot project

Working with Spring Data (JPA and JDBC)

Manage transaction



# Workshop



# **Spring Testing, TDD**

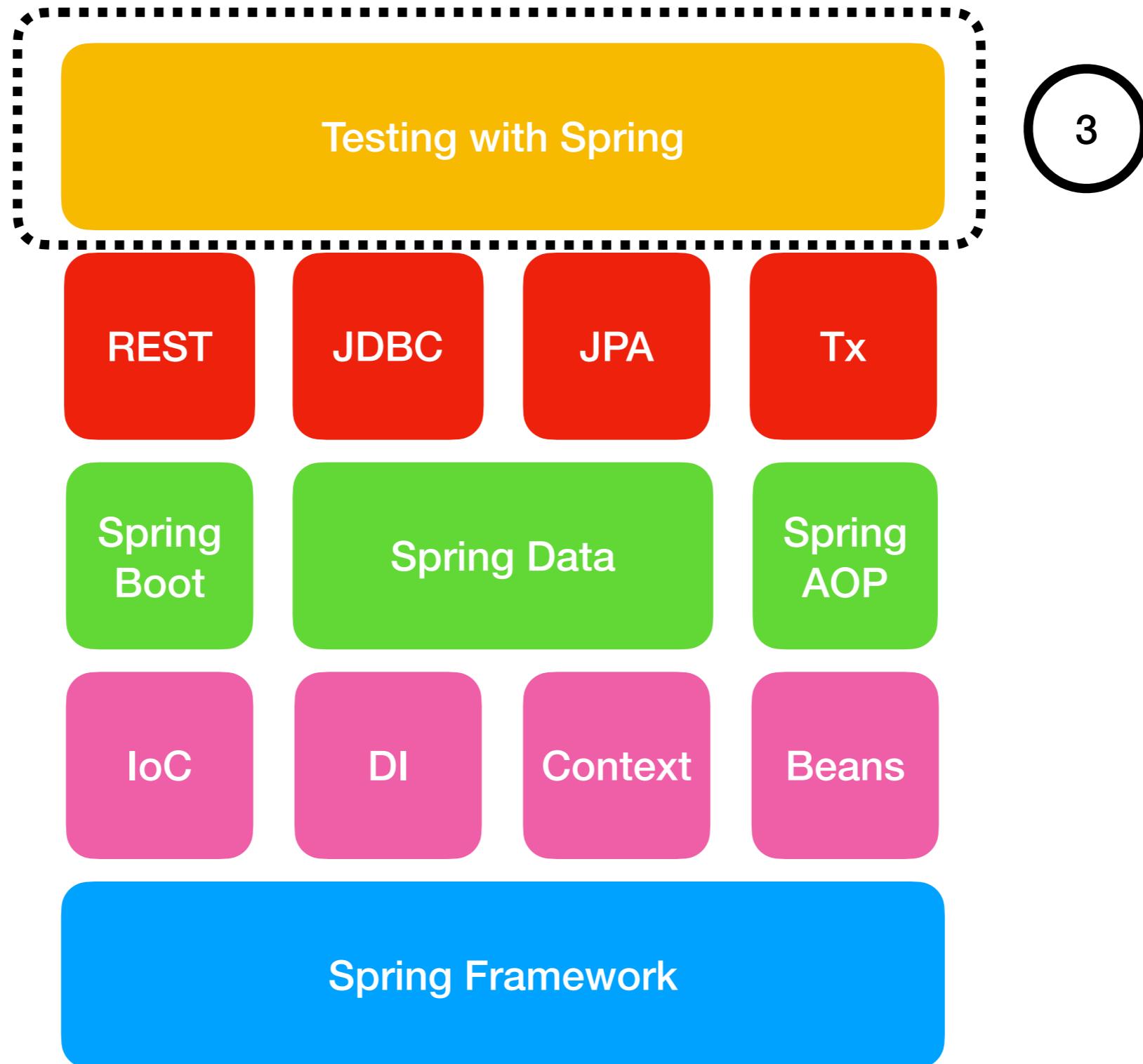


# Agenda

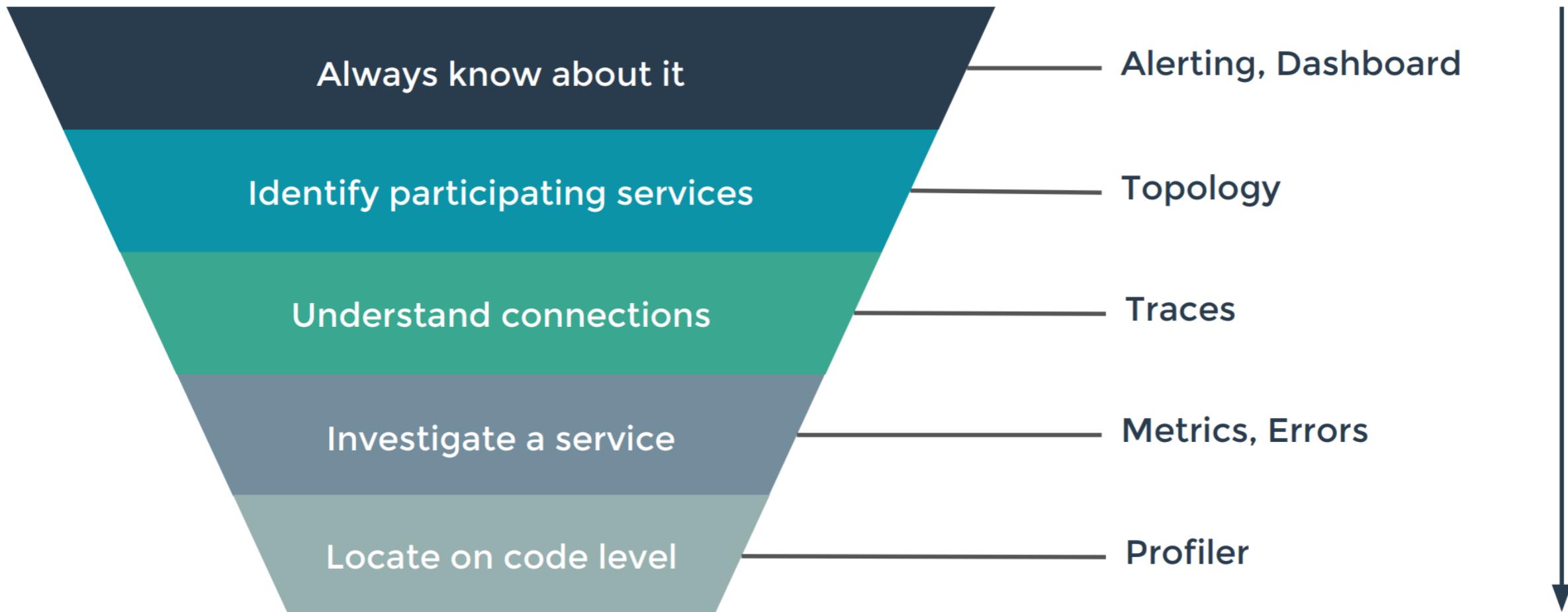
Test-Driven Development (TDD)  
Testing with Spring Boot  
Controller testing  
Service testing  
Repository testing  
Test double (Stub, Spy and Mocking)  
Learn JUnit 5 and Mockito  
Code coverage



# Workshop



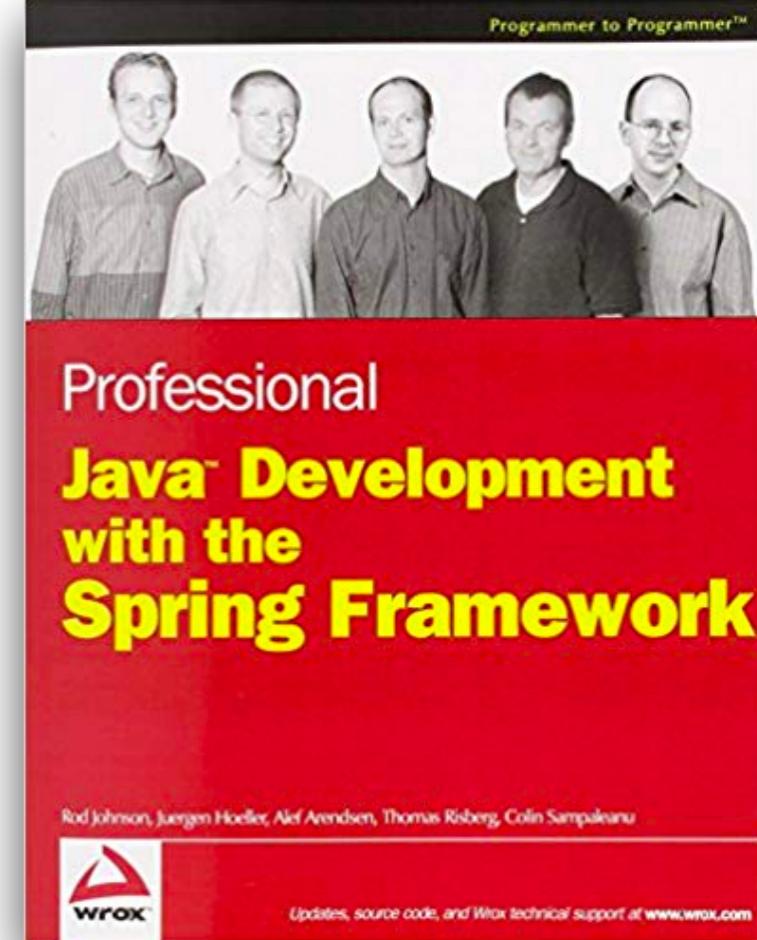
# Workshop



# Introduction to Spring Framework

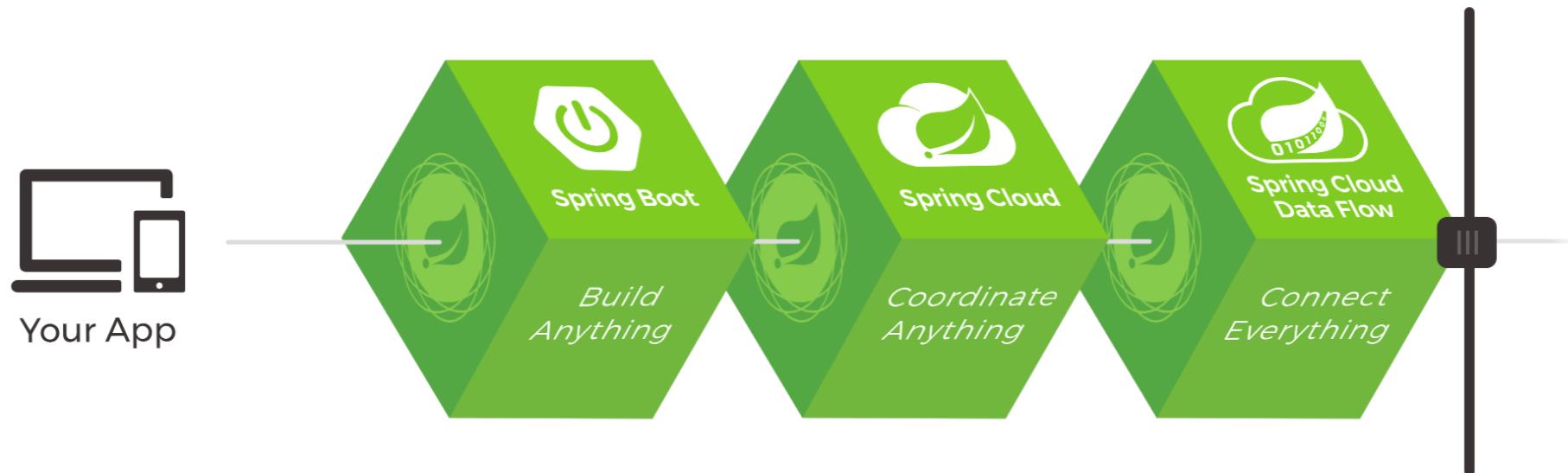


# History



# Spring ?

Spring: the source for modern java



## Spring Boot

### BUILD ANYTHING

Spring Boot is designed to get you up and running as quickly as possible, with minimal upfront configuration of Spring. Spring Boot takes an opinionated view of building production-ready applications.

## Spring Cloud

### COORDINATE ANYTHING

Built directly on Spring Boot's innovative approach to enterprise Java, Spring Cloud simplifies distributed, microservice-style architecture by implementing proven patterns to bring resilience, reliability, and coordination to your microservices.

## Spring Cloud Data Flow

### CONNECT ANYTHING

Connect the Enterprise to the Internet of Anything—mobile devices, sensors, wearables, automobiles, and more. Spring Cloud Data Flow provides a unified service for creating composable data microservices that

<https://spring.io/>



# Spring Projects

Modular by design

Spring Framework

Spring Boot

Spring Data Flow

Spring Cloud

Spring Data

Spring Integration

Spring Batch

Spring Security

Spring AMQP

Spring LDAP

Spring WebFlow

Spring REST Doc

<https://spring.io/projects>



# Spring Framework



# What ?

Application development framework for Java  
Create high performing, testable and reusable  
code without any lock-in

Open source since 2003  
Reduce code and speed up development



# Why Spring is popular ?

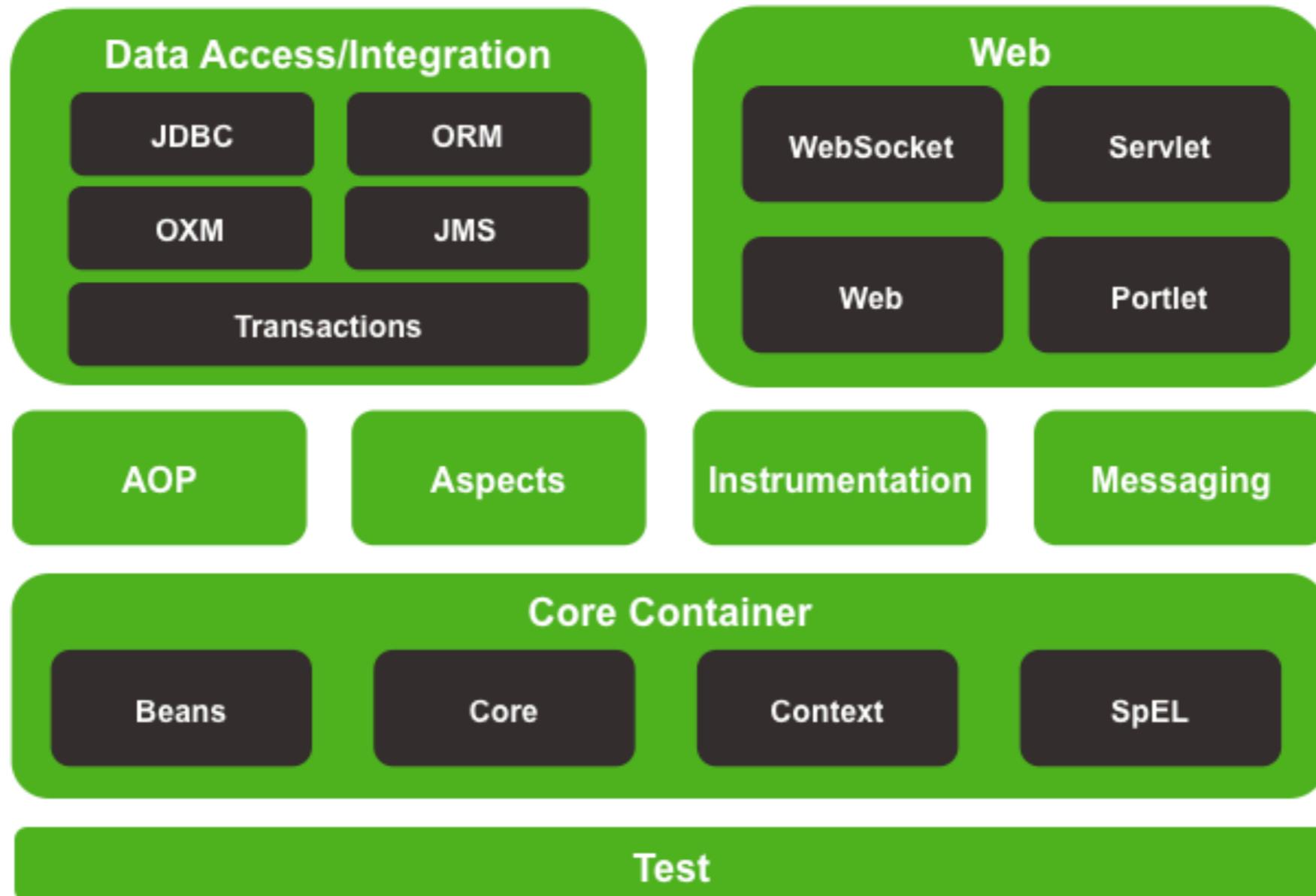
- Enable testable code
- No plumbing code
- Flexible architecture
- Staying current



# Overview of Spring Framework



## Spring Framework Runtime



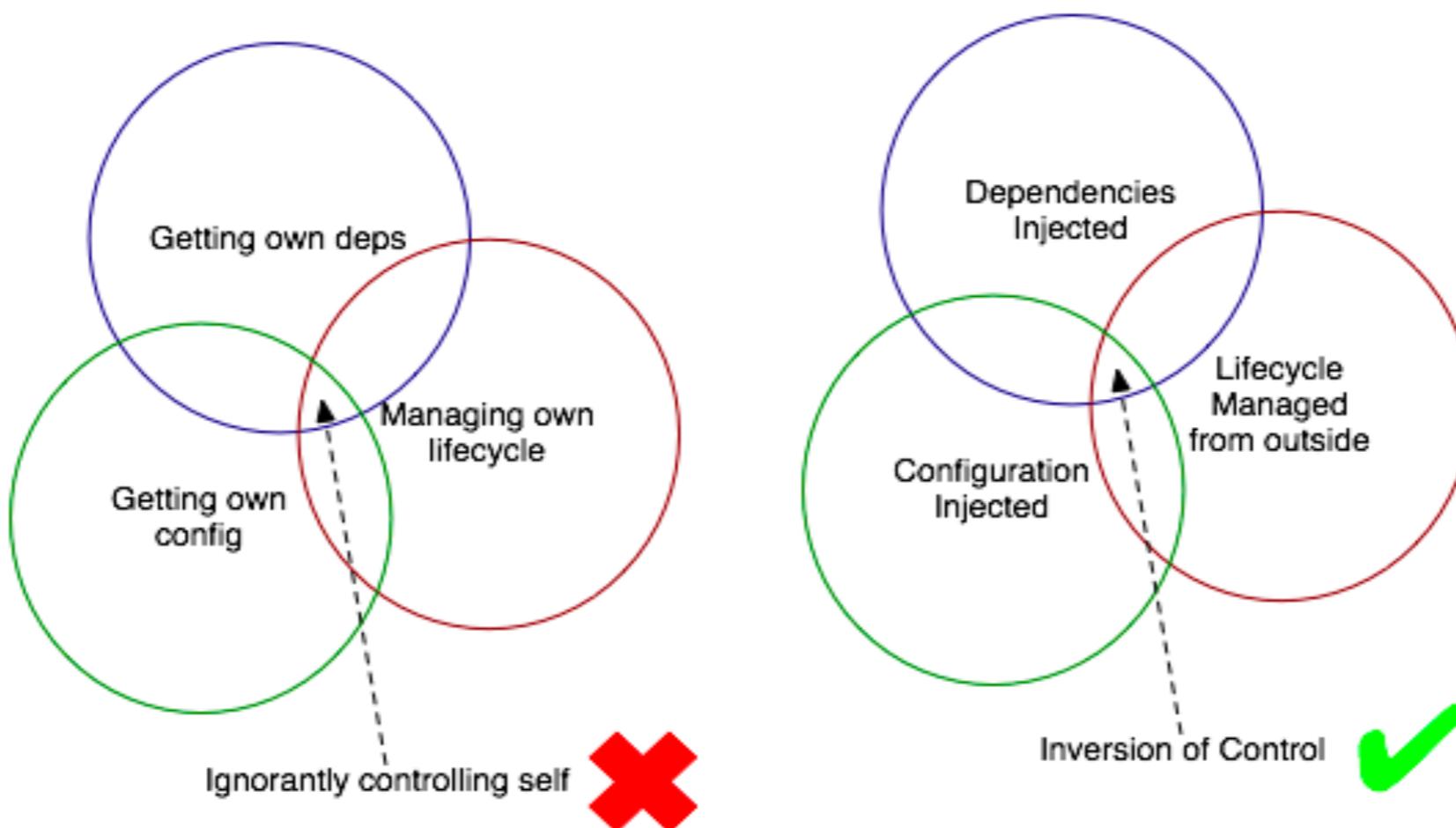
# Core Container

Core and Beans  
Context  
Expression language



# Core and Beans

Provide the fundamental parts of framework  
Including IoC and Dependency Injection



<https://www.martinfowler.com/articles/injection.html>



# Inversion of Control (IoC)

Concept in application development

**Don't call me, I will call you**



# Inversion of Control (IoC)

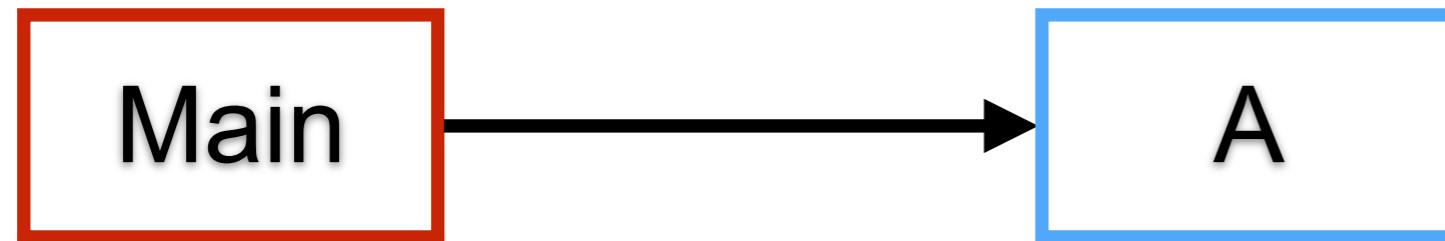
**Container maintains** your class dependencies

**Objects injected** at runtime or startup time

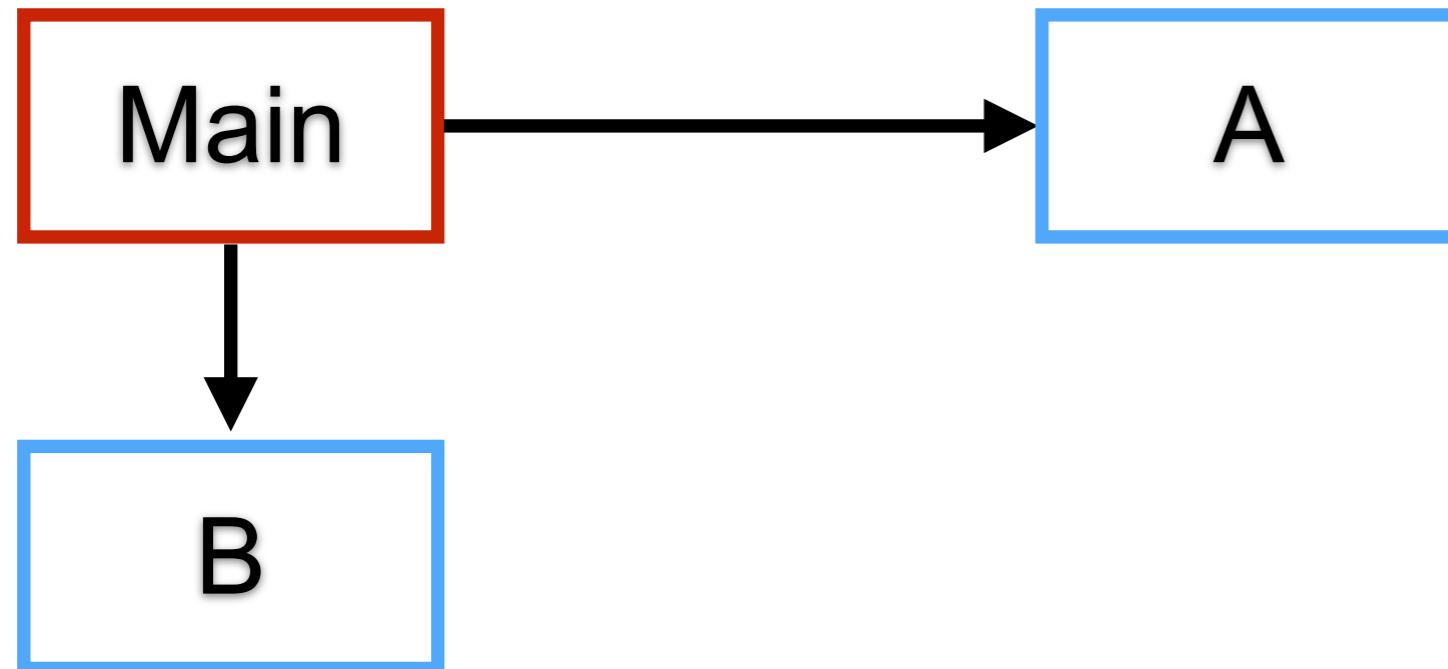
Object accepts the dependencies for construction instead of constructing them



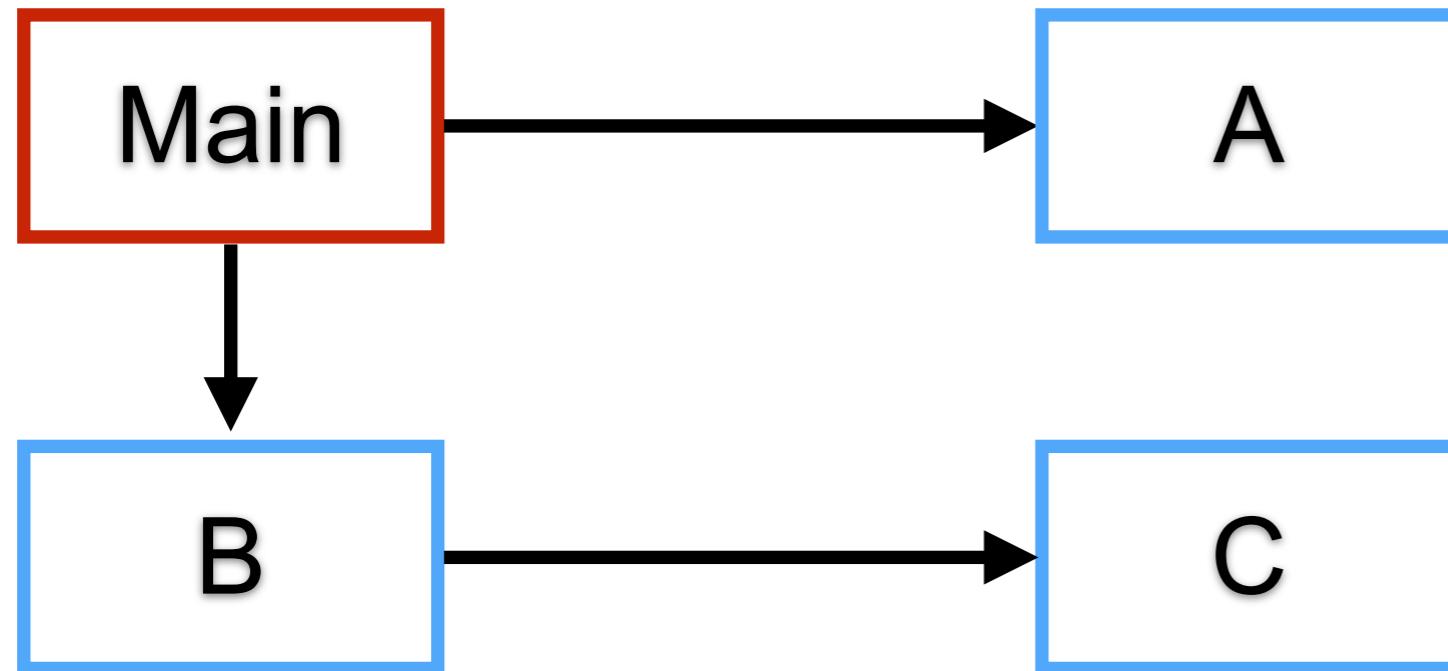
# Traditional Dependency Management



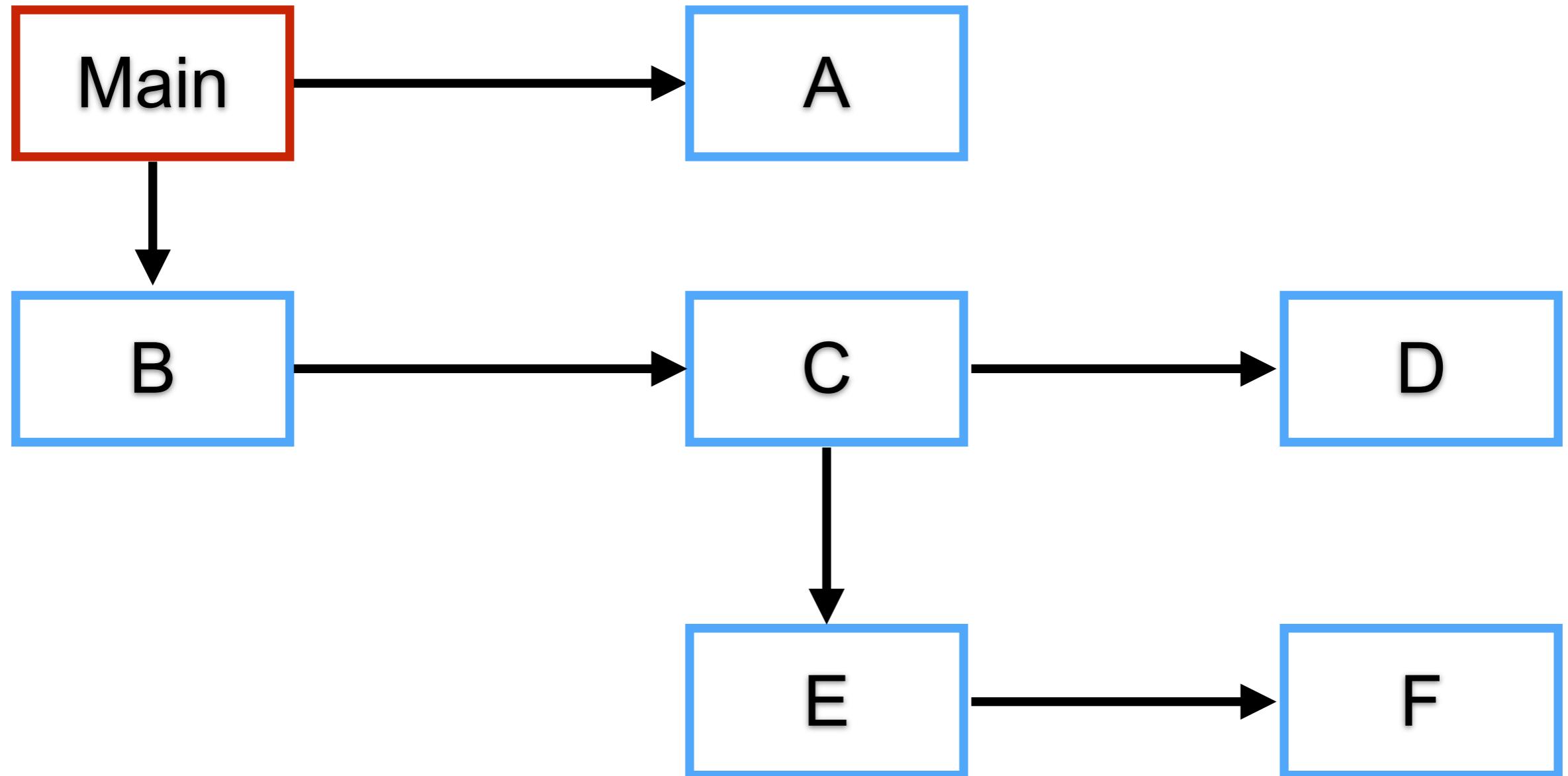
# Traditional Dependency Management



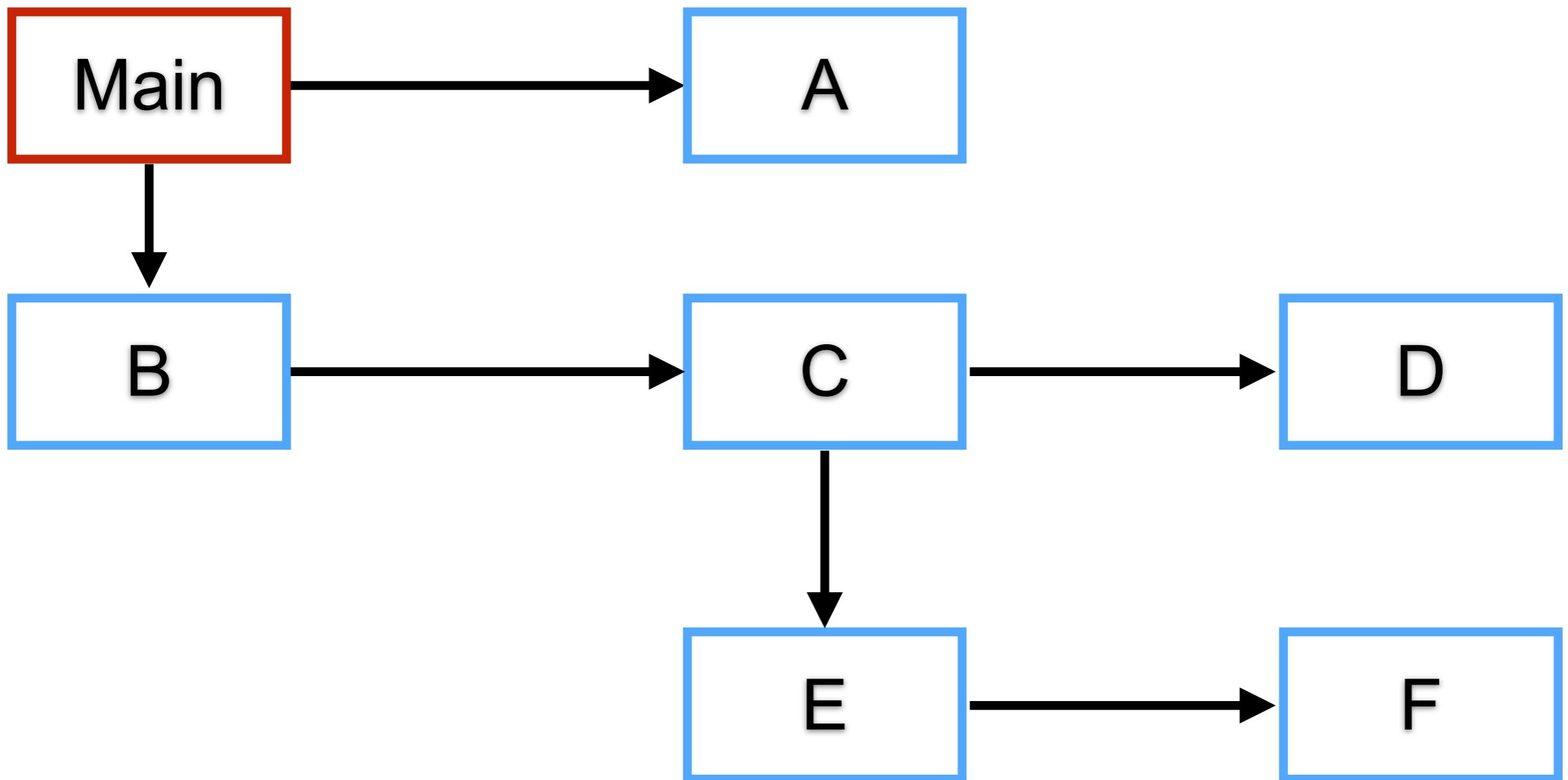
# Traditional Dependency Management



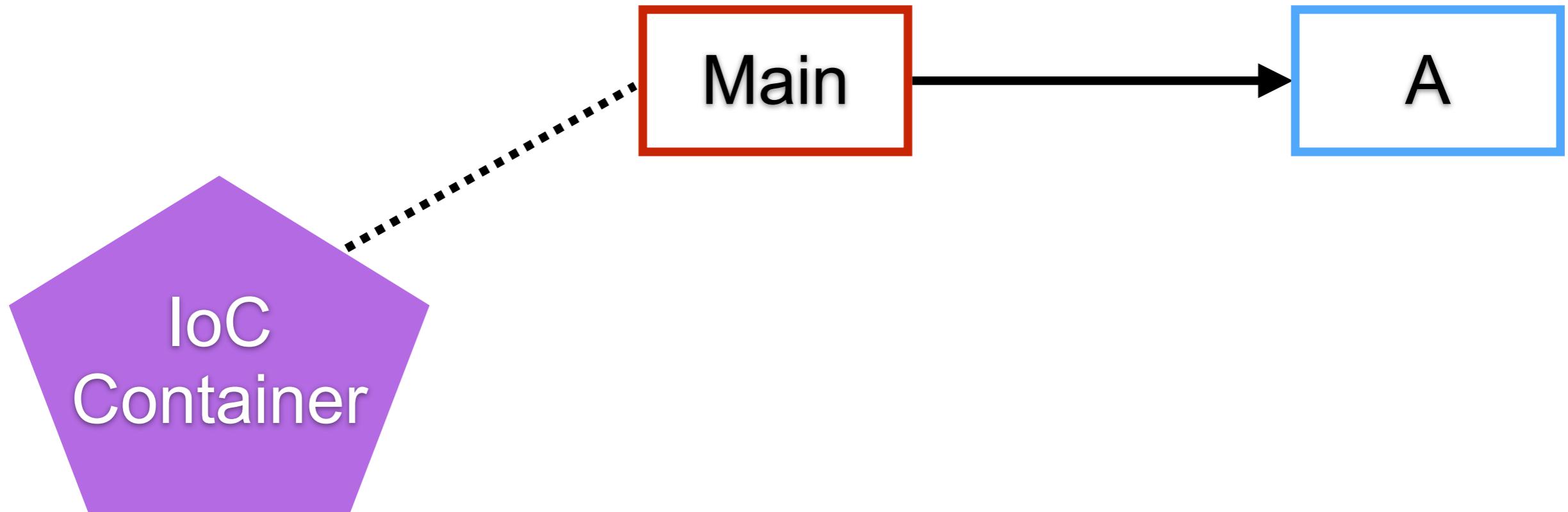
# Traditional Dependency Management



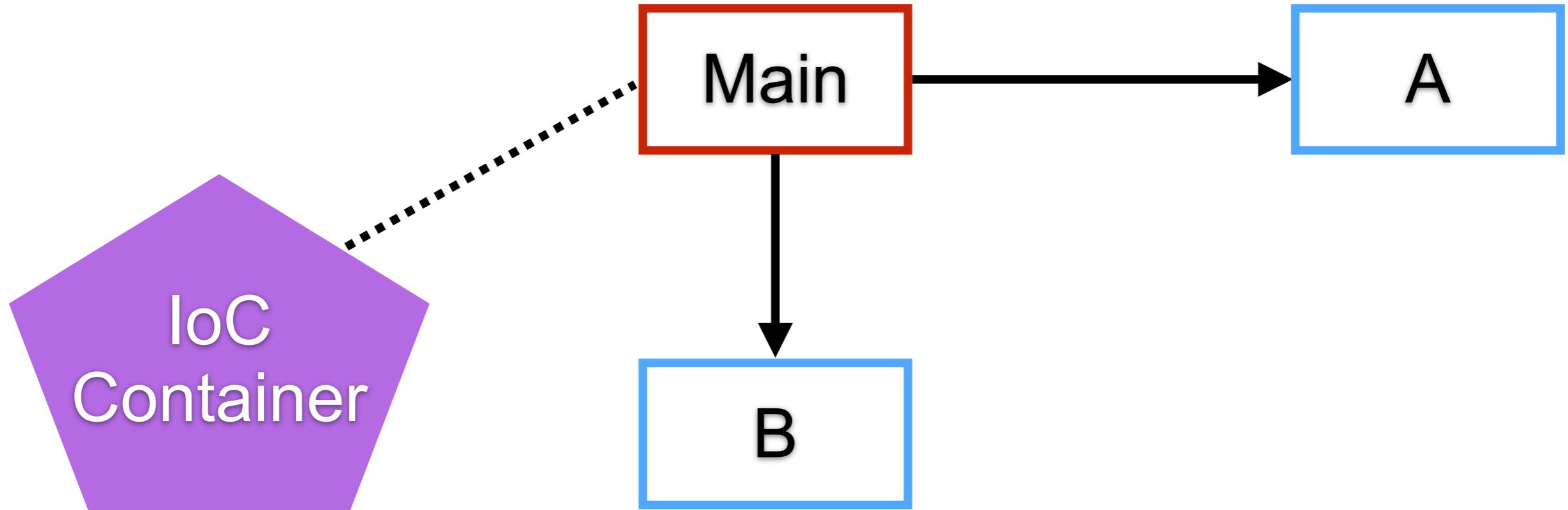
# Dependency Graph !!



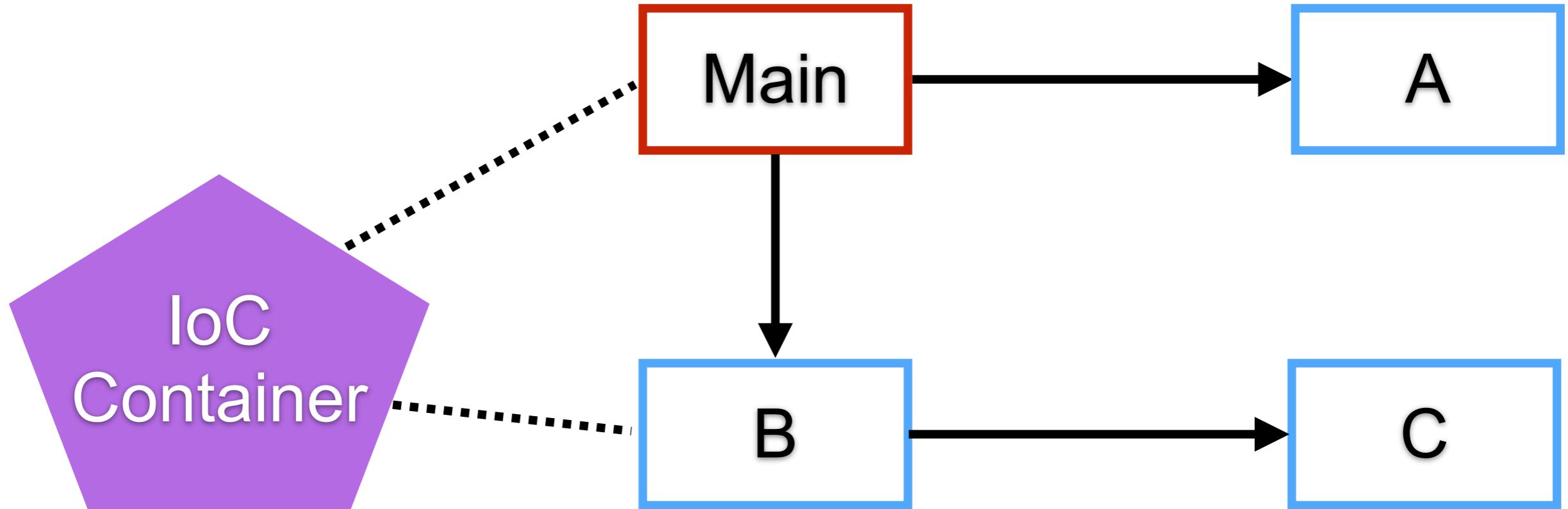
# IoC Dependency Management



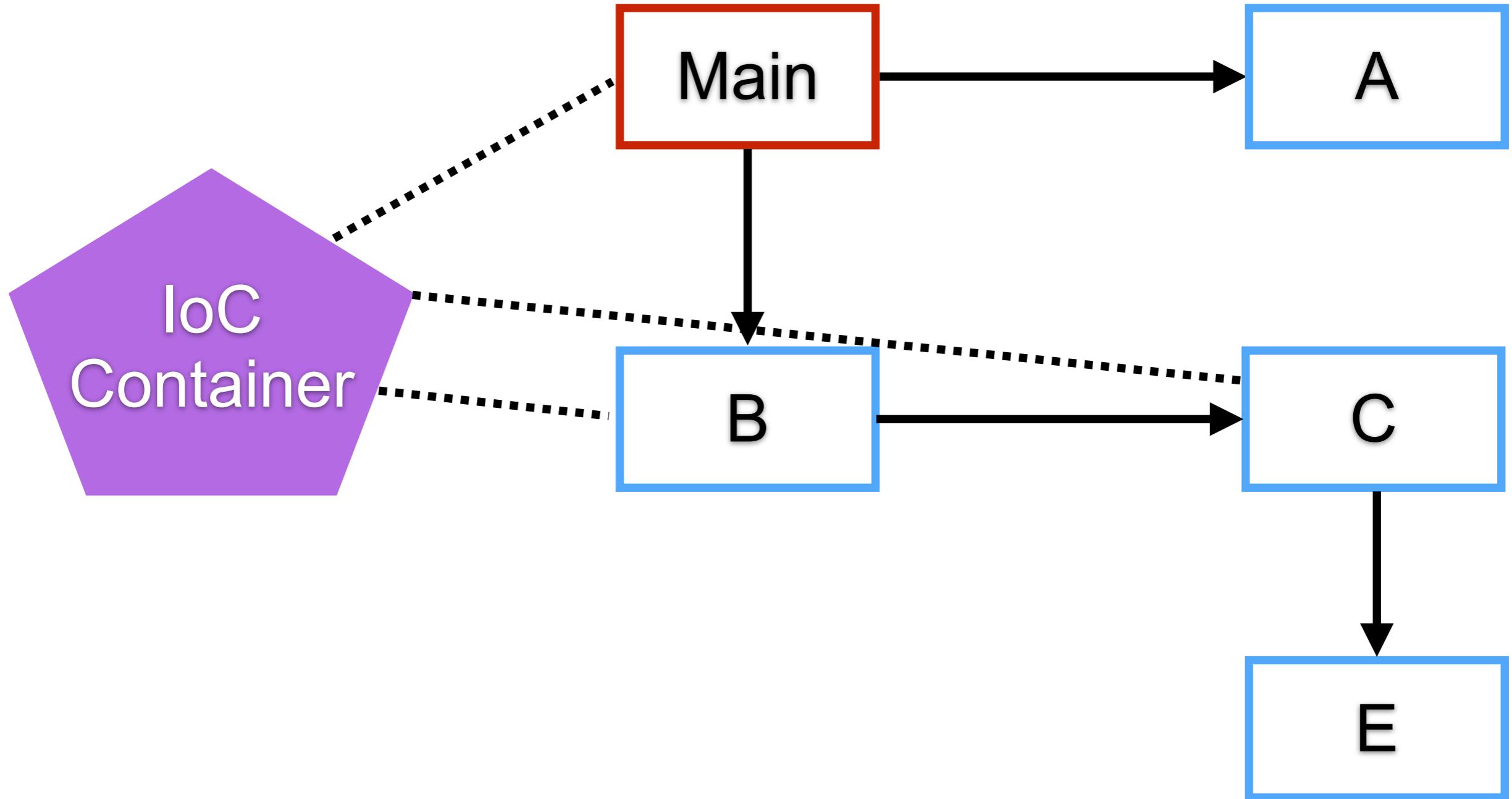
# IoC Dependency Management



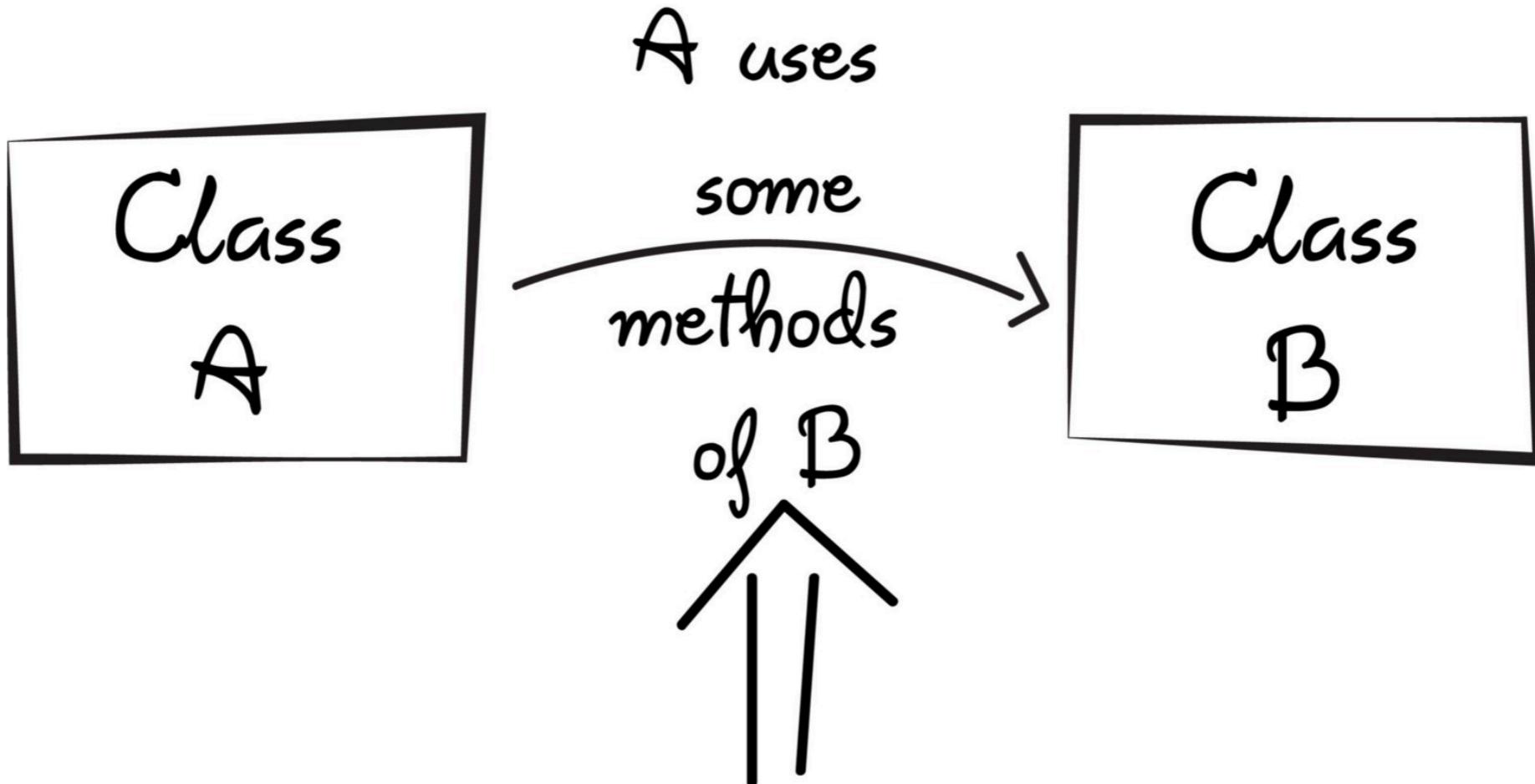
# IoC Dependency Management



# IoC Dependency Management



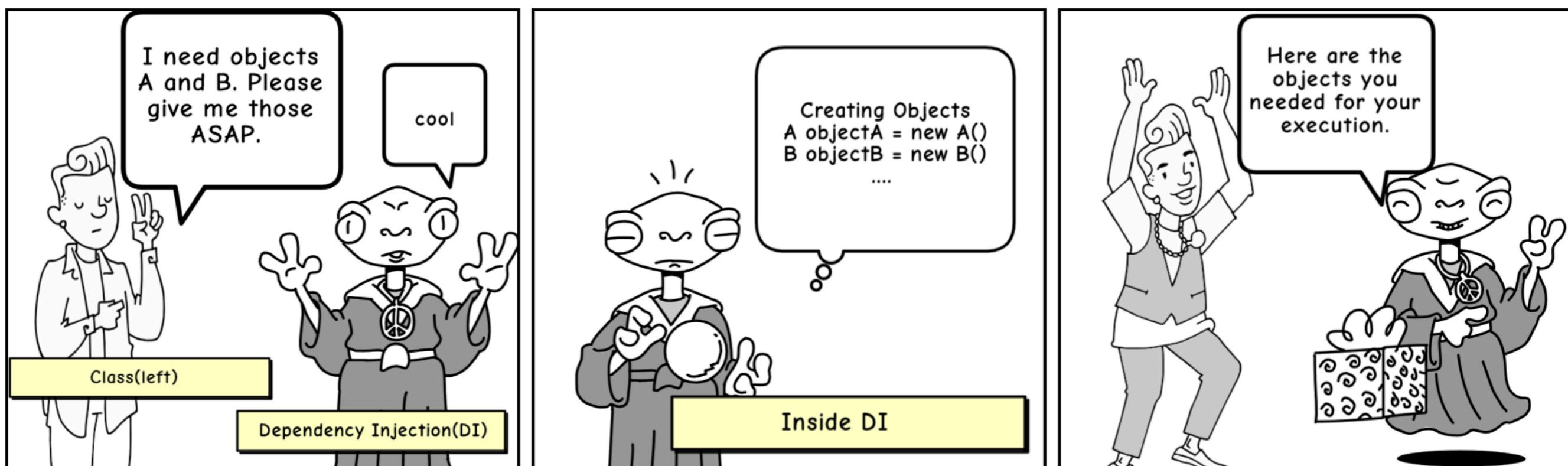
# Dependency Injection (DI)



Its a dependency



# Dependency Injection

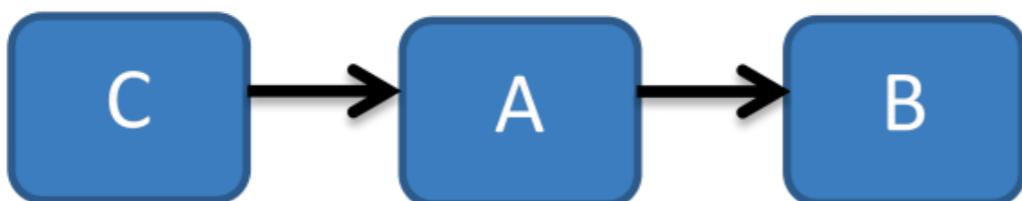


This comic was created at [www.MakeBeliefsComix.com](http://www.MakeBeliefsComix.com). Go there and make one now!

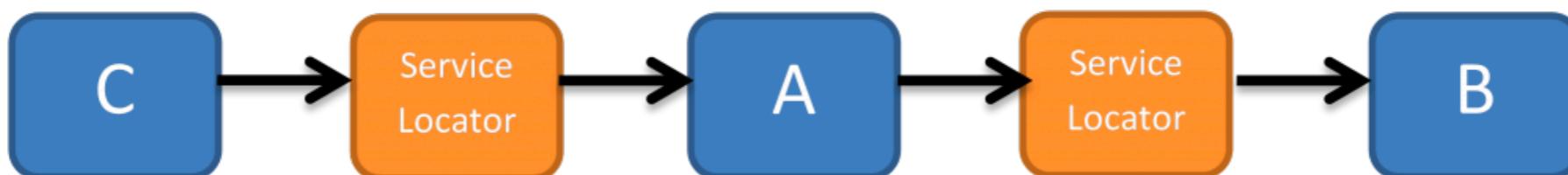


# Dependency Injection

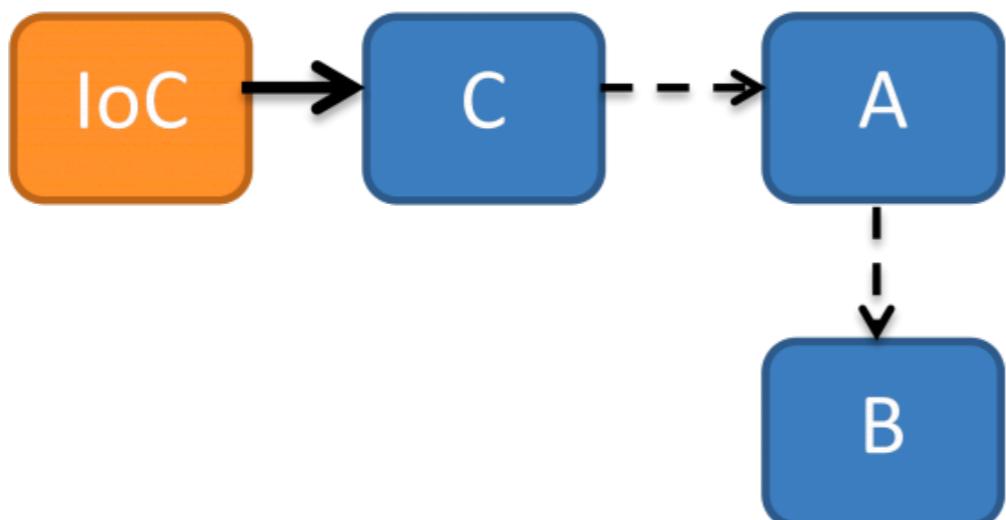
Class Dependencies



Service Location / Active Calling



IoC / DI / Auto-Wiring / Passive Calling



# Types of Dependency Injection

Constructor injection

Property/Setter injection

Method injection

Interface injection



# Benefit of DI

Reduces noise in your code

Reduces object coupling

Reduces defects that arise from incorrect construction

Focus on the API contract



# Example of DI



# Back to Spring Framework



# Create new Project

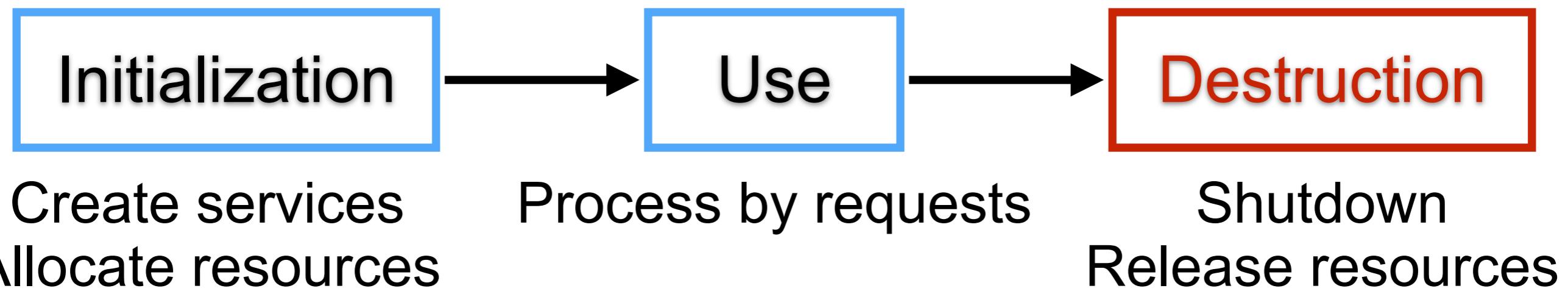
Use spring initializr

The screenshot shows the Spring Initializr web application interface. At the top left is the logo 'spring initializr'. Below it are sections for 'Project' (Maven Project selected), 'Language' (Java selected), and 'Dependencies' (No dependency selected). Under 'Spring Boot', version 2.4.1 is selected. The 'Project Metadata' section includes fields for Group (com.example), Artifact (demo), Name (demo), Description (Demo project for Spring Boot), Package name (com.example.demo), Packaging (Jar selected), and Java version (11 selected). A 'Dependencies' sidebar on the right has an 'ADD DEPENDENCIES...' button.

<https://start.spring.io/>



# Application Lifecycle



Initialization

Create services  
Allocate resources

Use

Process by requests

Destruction

Shutdown  
Release resources



# 1. Initialization phase

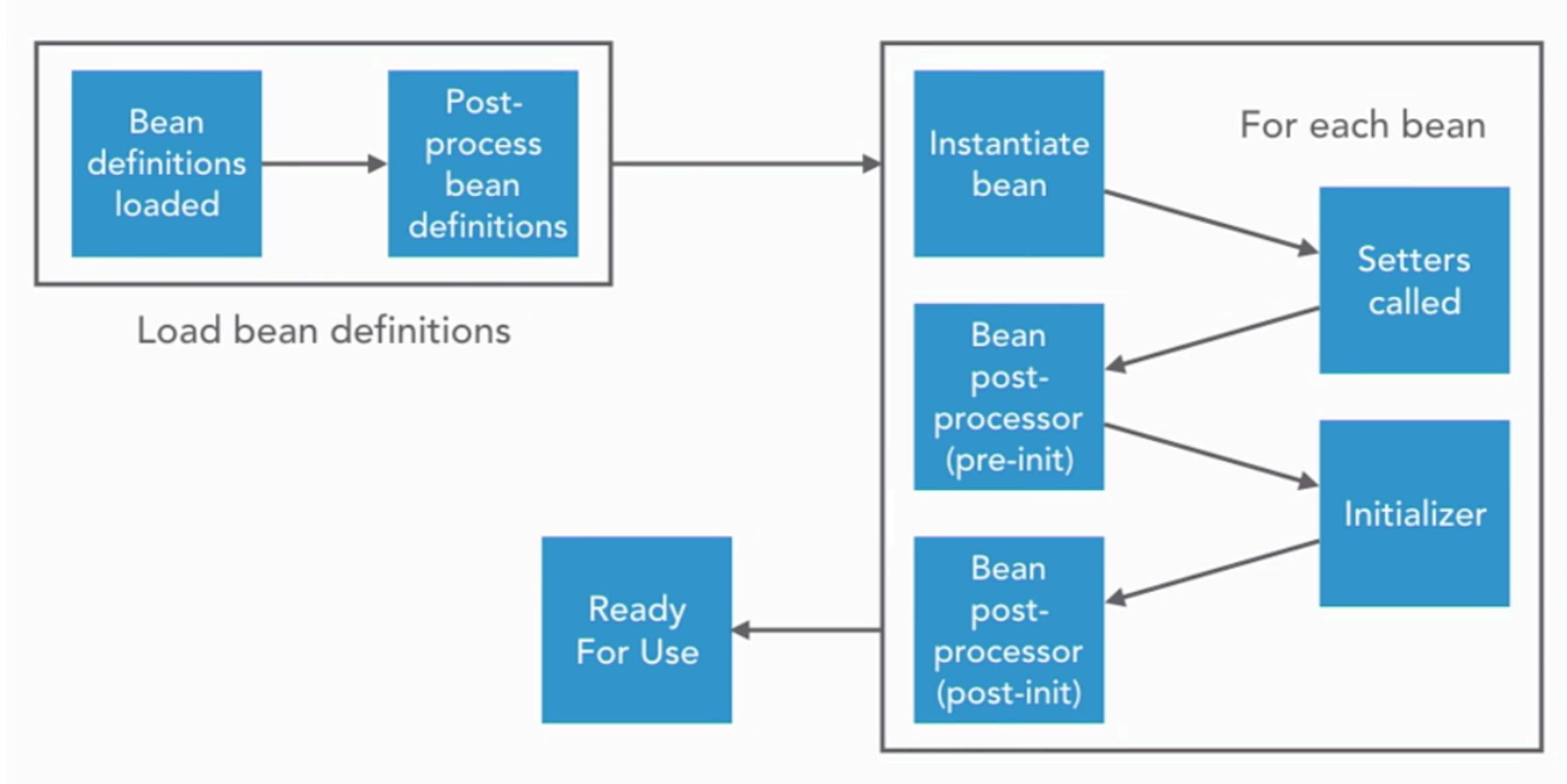
Begins with creation of **ApplicationContext**

    BeanFactory initialisation phase

    Bean initialisation and instantiation



# Initialization phase



# Initialization phase

Begins with creation of **ApplicationContext**

    BeanFactory initialisation phase

    Bean initialisation and instantiation



# ApplicationContext

Act as heart of Spring Application

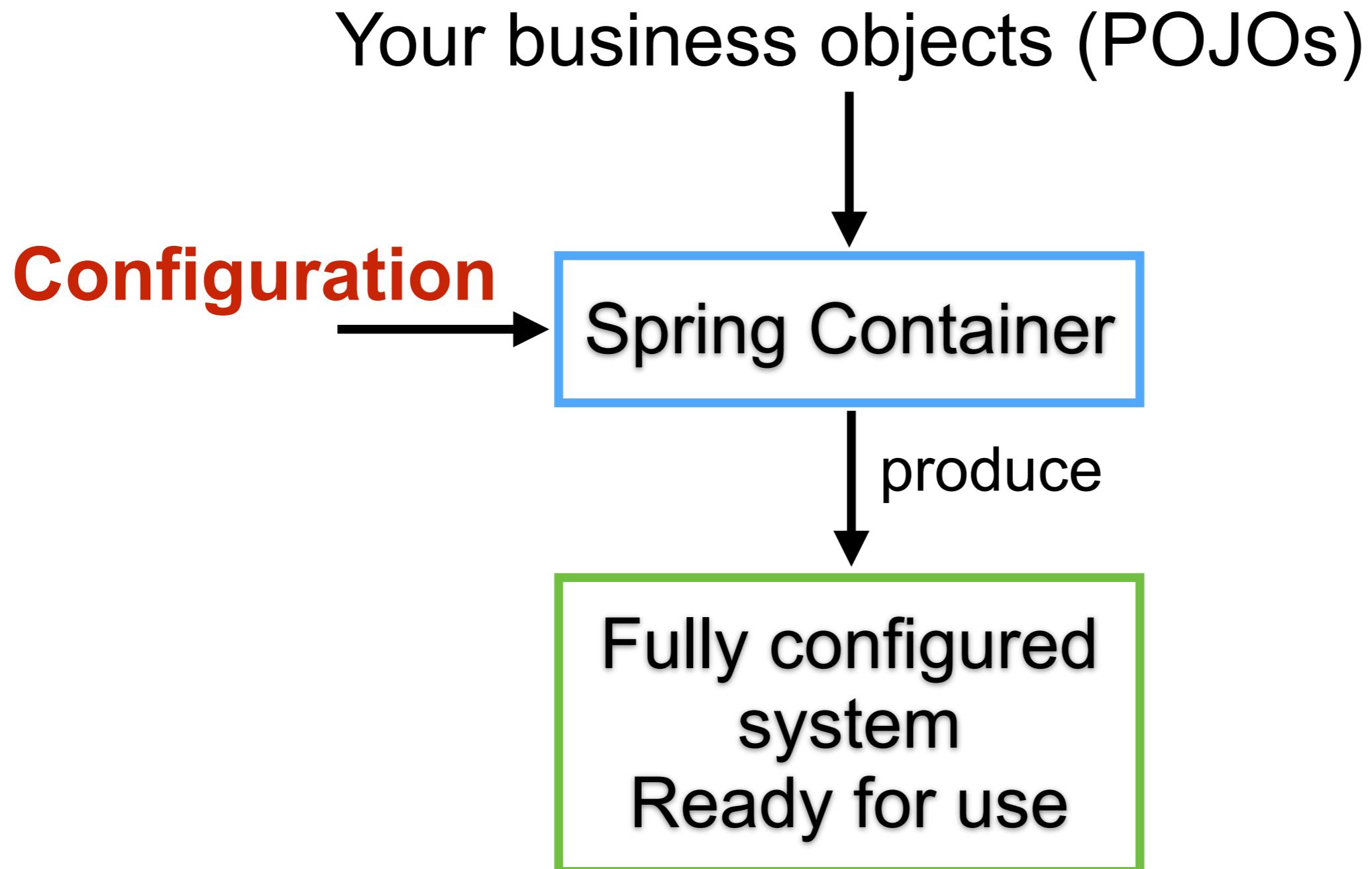
Encapsulate the BeanFactory

Provides metadata for bean creation

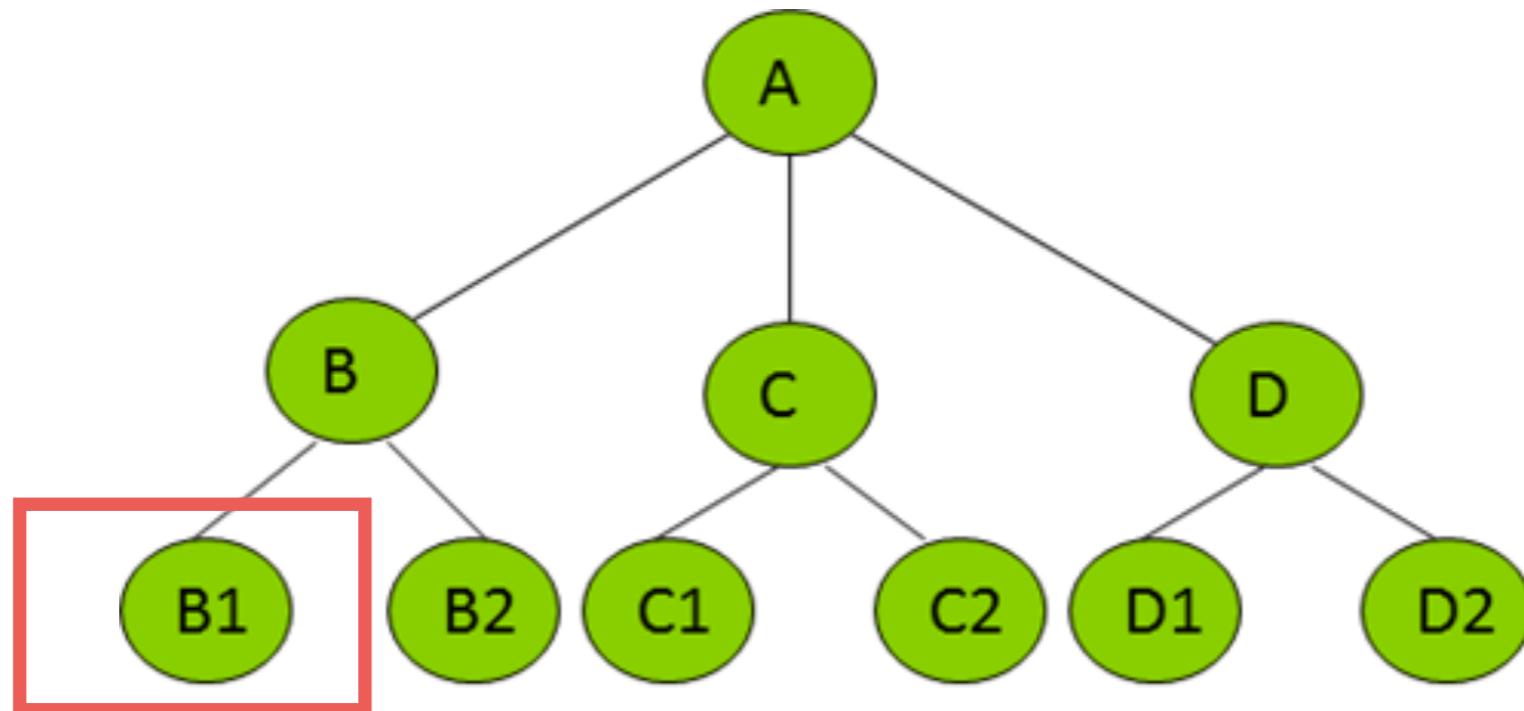
Provides mechanism for creation of beans in  
the correct way



# Spring IoC container



# Spring IoC container



Bean B1



# Configuration

From XML file

Annotation-based configuration (2.5)

**Java-based configuration (3.0)**



# Beans

Spring IoC container manages one or more beans  
Beans are created with configuration



# Bean Definitions

Package-qualified class name

Bean behavioral (scope, lifecycle, callback)

Reference to other beans

Other configuration setting to create new object



# Bean Definitions

Property	Section
Class	Instantiating beans
Name	Naming beans
Scope	Beans scopes
Constructor arguments	Dependency Injection
Properties	Dependency Injection
Autowiring mode	Autowiring collaborators
Lazy initialization mode	Lazy-initialized beans

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



# Bean Scopes

Scope	Description
<b>singleton</b>	Single instance for each container
prototype	Single bean definition to any number of object instances.
request	HTTP request
session	HTTP session
application	ServletContext

<https://docs.spring.io/spring/docs/current/spring-framework-reference/core.html#beans-factory-scopes>



# Singletons

Default scope of every bean  
On instance per context definition  
**Be careful with state data**



# Prototype

New instance every time it is reference  
Useful for data/types that flex based on application state



# Session

Applies to web environment only  
On instance of bean per user session



# Request

Applies to web environment only  
On instance of bean per request

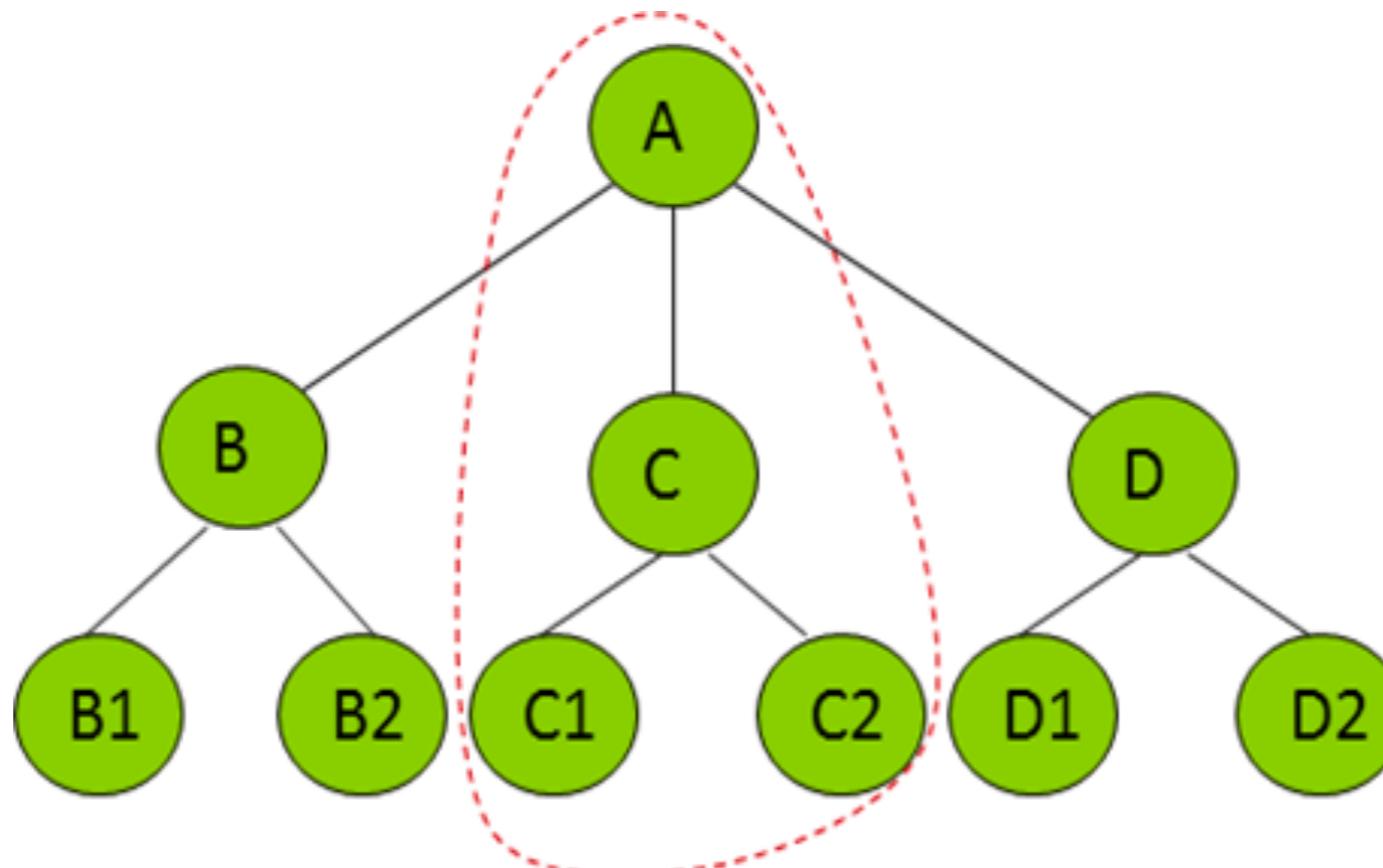


# Change scope of bean

```
@Component  
@Scope(ConfigurableBeanFactory.SCOPE_PROTOTYPE)  
public class RealRandom implements MyRandom {  
  
    public String number;  
  
    @Override  
    public int nextInt(int bound) {  
        return new Random().nextInt(bound);  
    }  
}
```



# Lazy-load dependencies



# **BeanFactory ?**

Interface defines basic functionality for Spring container

## **Factory design pattern**

Load beans from configuration source

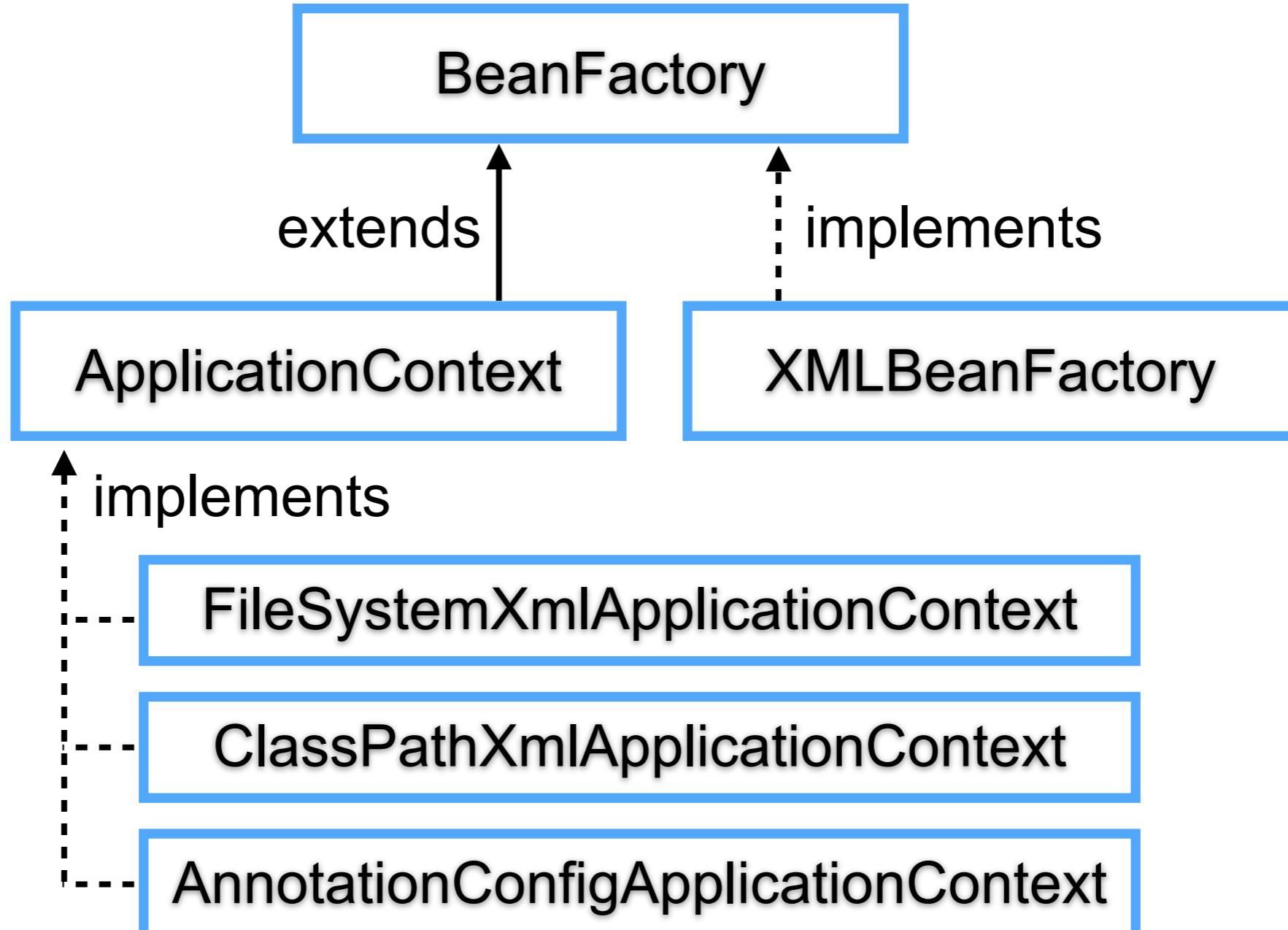
Instantiated the bean when requested

Wire dependencies and properties for beans

Manage the bean lifecycle



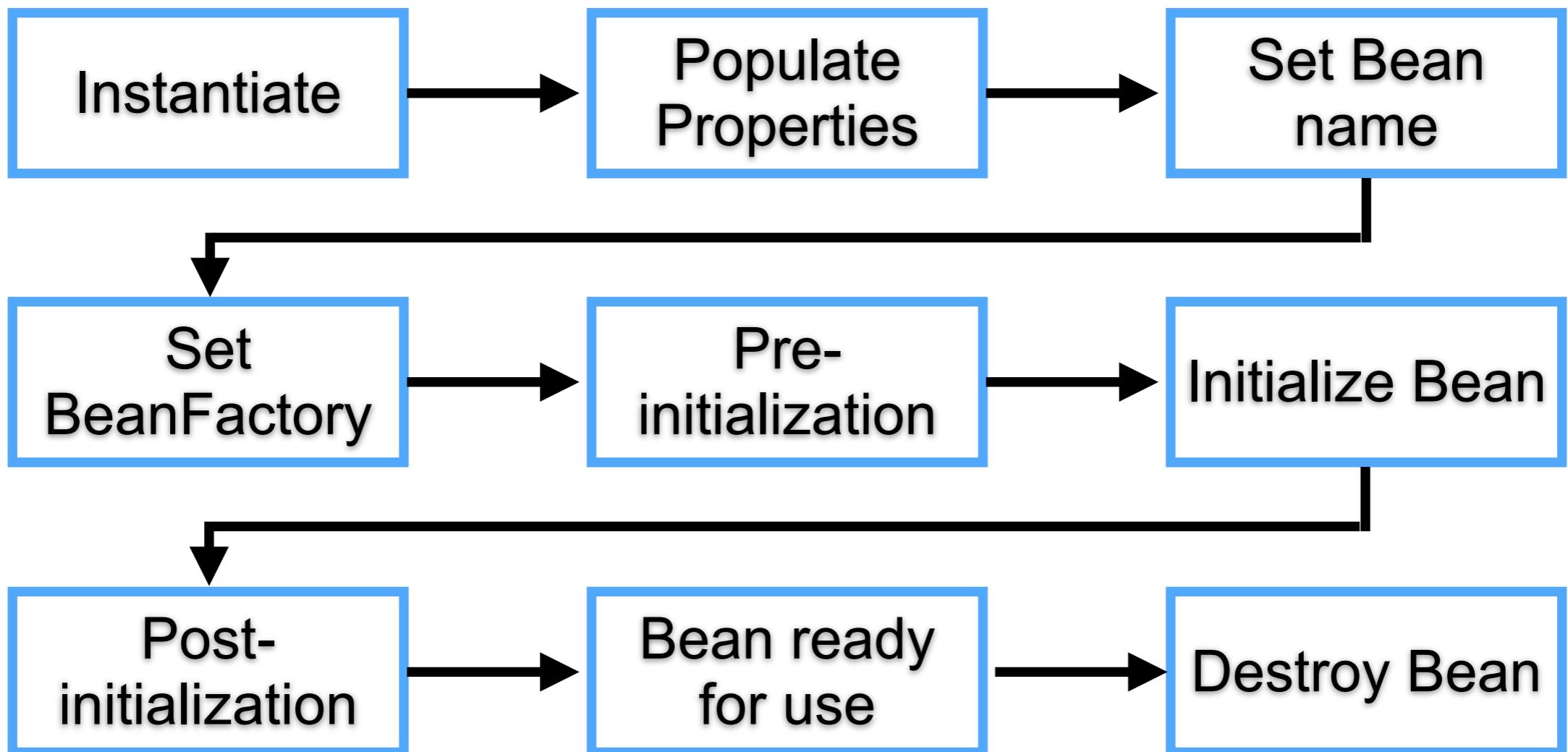
# BeanFactory ?



<https://docs.spring.io/spring-framework/docs/current/javadoc-api/org/springframework/context/ApplicationContext.html>



# Lifecycle of BeanFactory

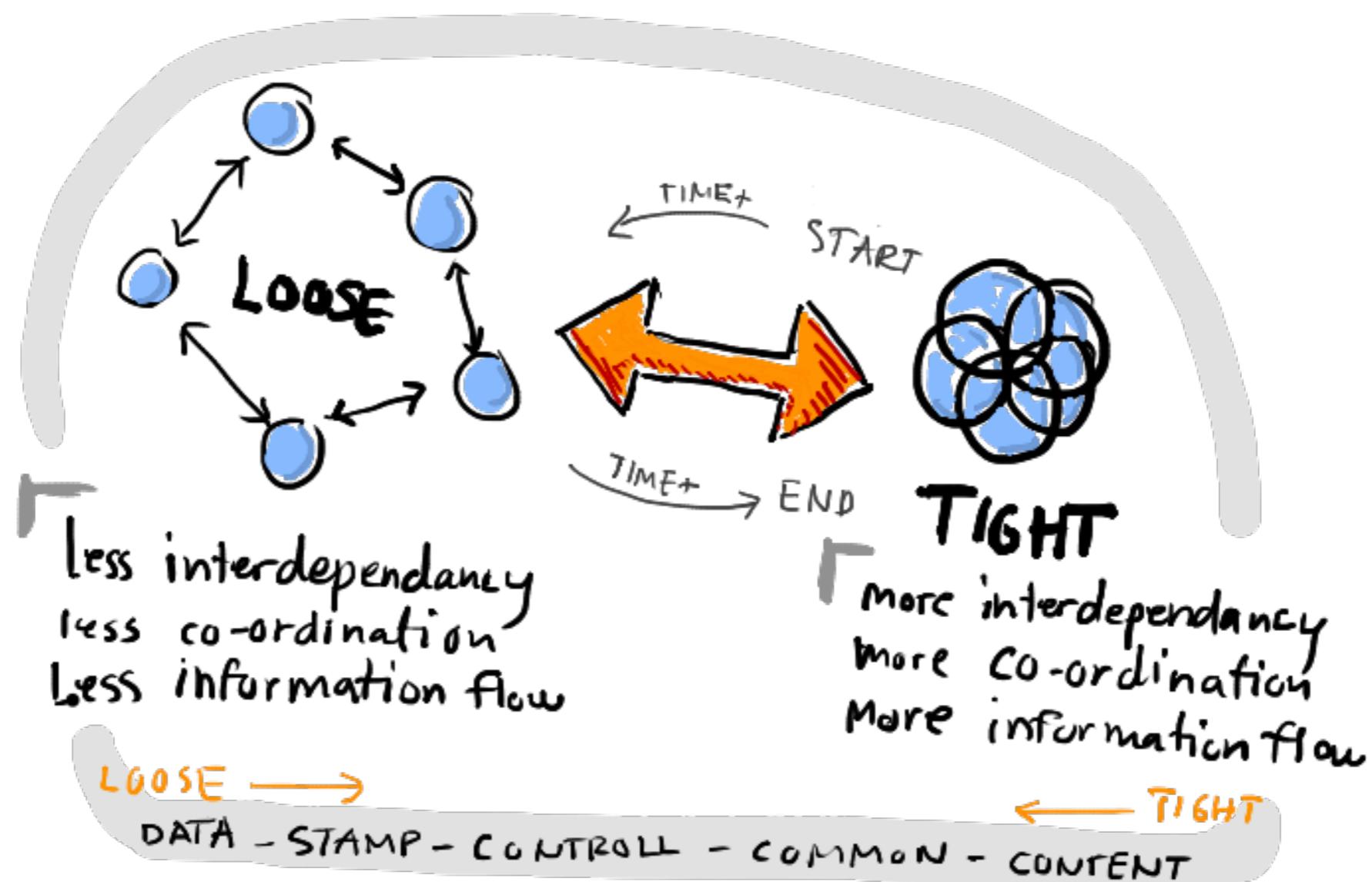


# Let's start Spring Framework



# Understanding Dependency Injection

Tight coupling  
Loose coupling



# Component Scanning



# Using Spring to manage dependencies

@Component

@Autowired

Constructor and Setter injection

@Primary

@Qualifier



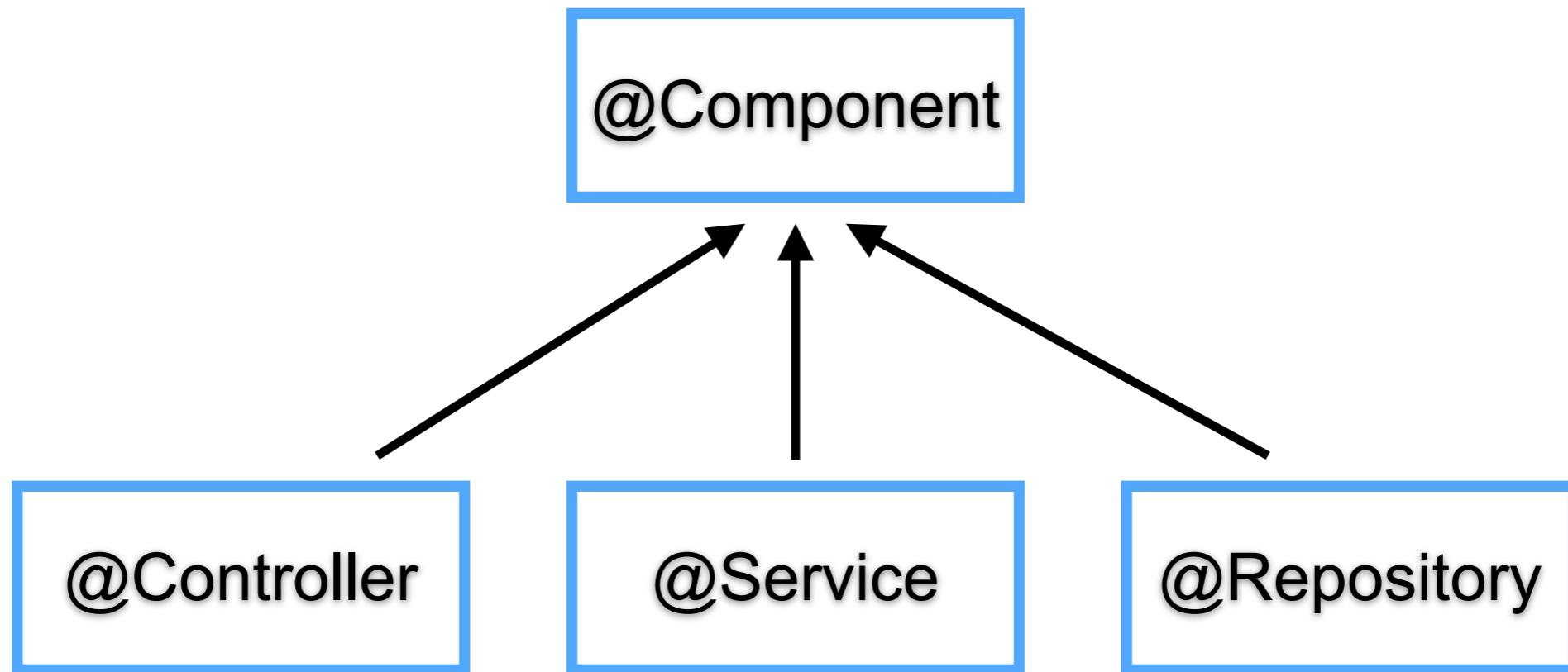
# @Component

Indicates that a class should be loaded into BeanFactory

Component scanning scans a **base package** and load configuration automatically for each bean it finds



# What are difference of ...



# Layer of application



# What are difference of ...

## **@Component**

Generic stereotype for any component or bean

## **@Controller**

Stereotype for the presentation layer (Spring MVC)

## **@Service**

Stereotype for the service layer

## **@Repository**

Stereotype for the persistence layer



# DI with Component Scanning

## **@Autowired**

Dependency injection

## **@Qualifier**

Used when multiple implementation of interface  
are needed

## **@Value**

Property injection



# Example of multiple implementation

```
public interface Formatter {  
}  
  
@Component  
class FirstFormatter implements Formatter {  
}  
  
@Component  
class SecondFormatter implements Formatter {  
}
```



# Example of multiple implementation

Get bean !!

```
@Component  
public class DemoComponent {  
  
    @Autowired  
    private Formatter formatter;  
  
}
```



# Error !!

Error creating bean with name 'demoComponent':  
Unsatisfied dependency expressed through field '**formatter**';  
nested exception is  
**org.springframework.beans.factory.NoUniqueBeanDefinitionException:**  
No qualifying bean of type 'com.example.demo.Formatter'  
available: expected single matching bean **but found 2:**  
**firstFormatter,secondFormatter**



# Solution #1

## Using @Qualifier

```
@Component  
@Qualifier("firstFormatter")  
class FirstFormatter implements Formatter {  
}
```

```
@Component  
@Qualifier("secondFormatter")  
class SecondFormatter implements Formatter {  
}
```

```
@Component  
public class DemoComponent {  
  
    @Autowired  
    @Qualifier("firstFormatter")  
    private Formatter formatter;  
  
}
```



# Solution #2

## Using @Primary

```
@Component  
class FirstFormatter implements Formatter {  
}  
  
@Component  
@Primary  
class SecondFormatter implements Formatter {  
}
```



# Solution #3

## Auto-wiring by name

```
@Component  
public class DemoComponent {  
  
    @Autowired  
    private Formatter secondFormatter;  
  
}
```



# Testable structure/application



# SOLID



**S**ingle Responsibility Principle

**O**pen Closed Principle

**L**iskov Substitution Principle

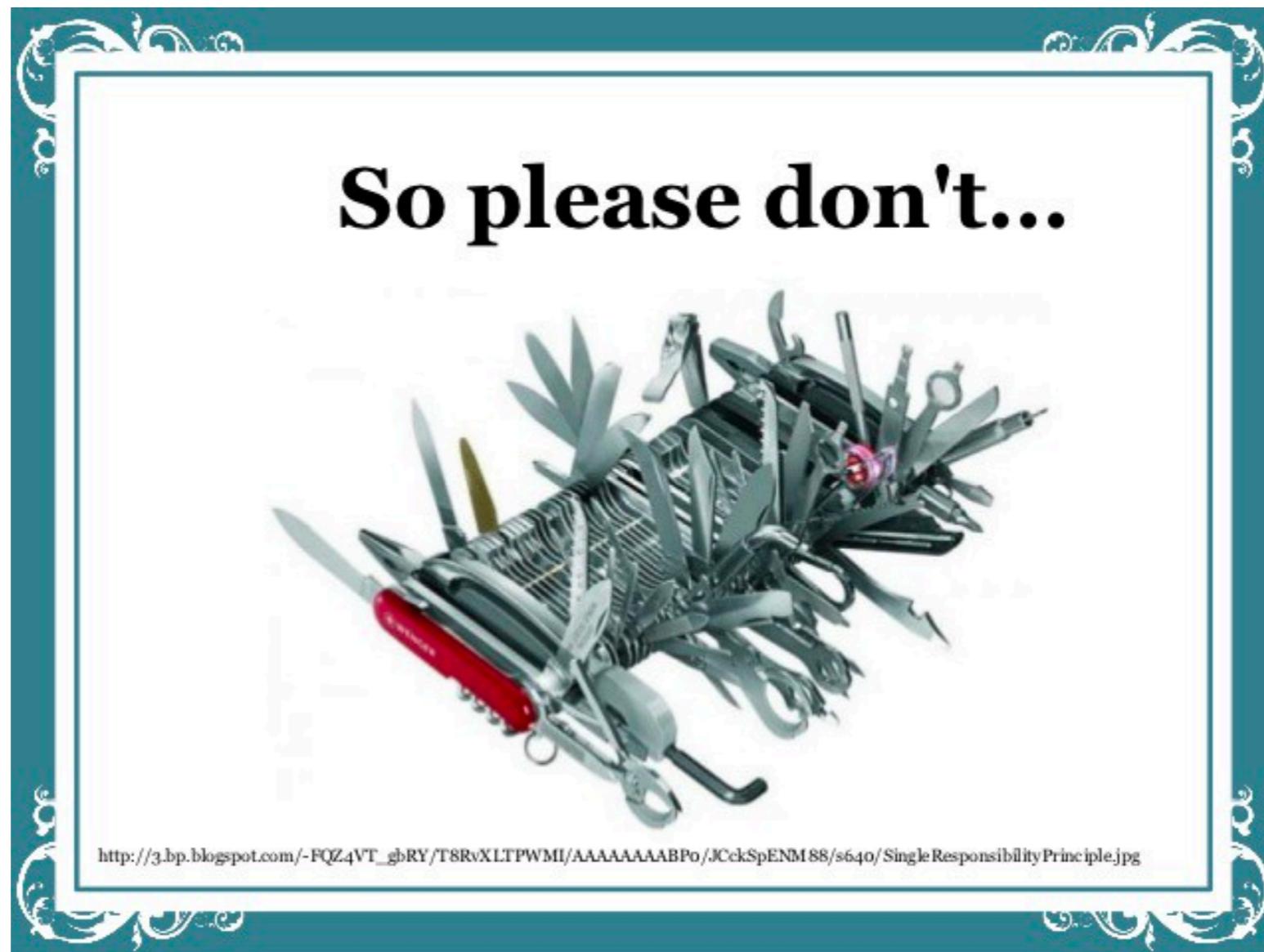
**I**nterface Segregation Principle

**D**ependency Inversion Principle



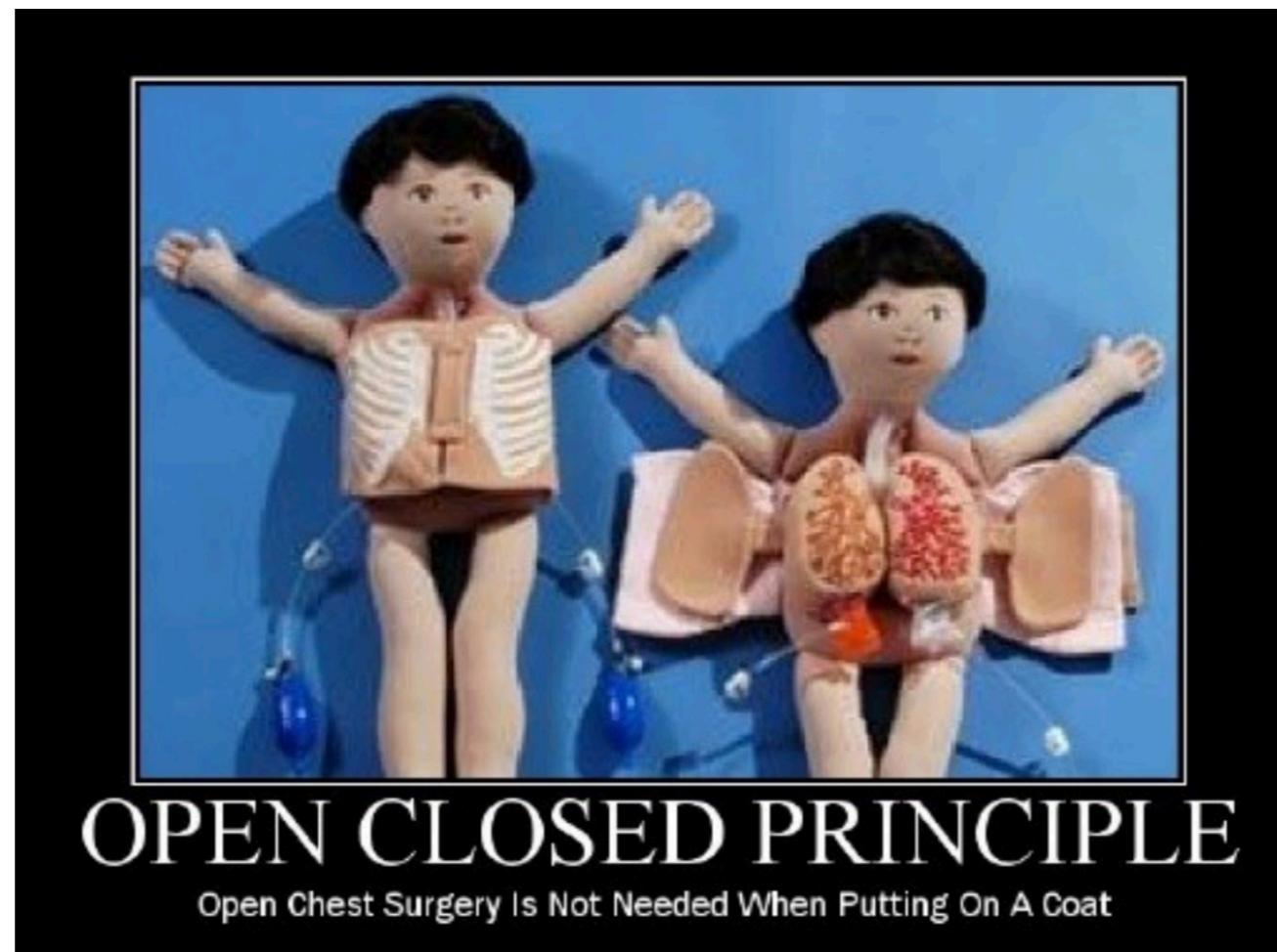
# Single Responsibility Principle

A class should have one and only one reason to change



# Open Closed Principle

Software entities should open for extension  
But closed for modification



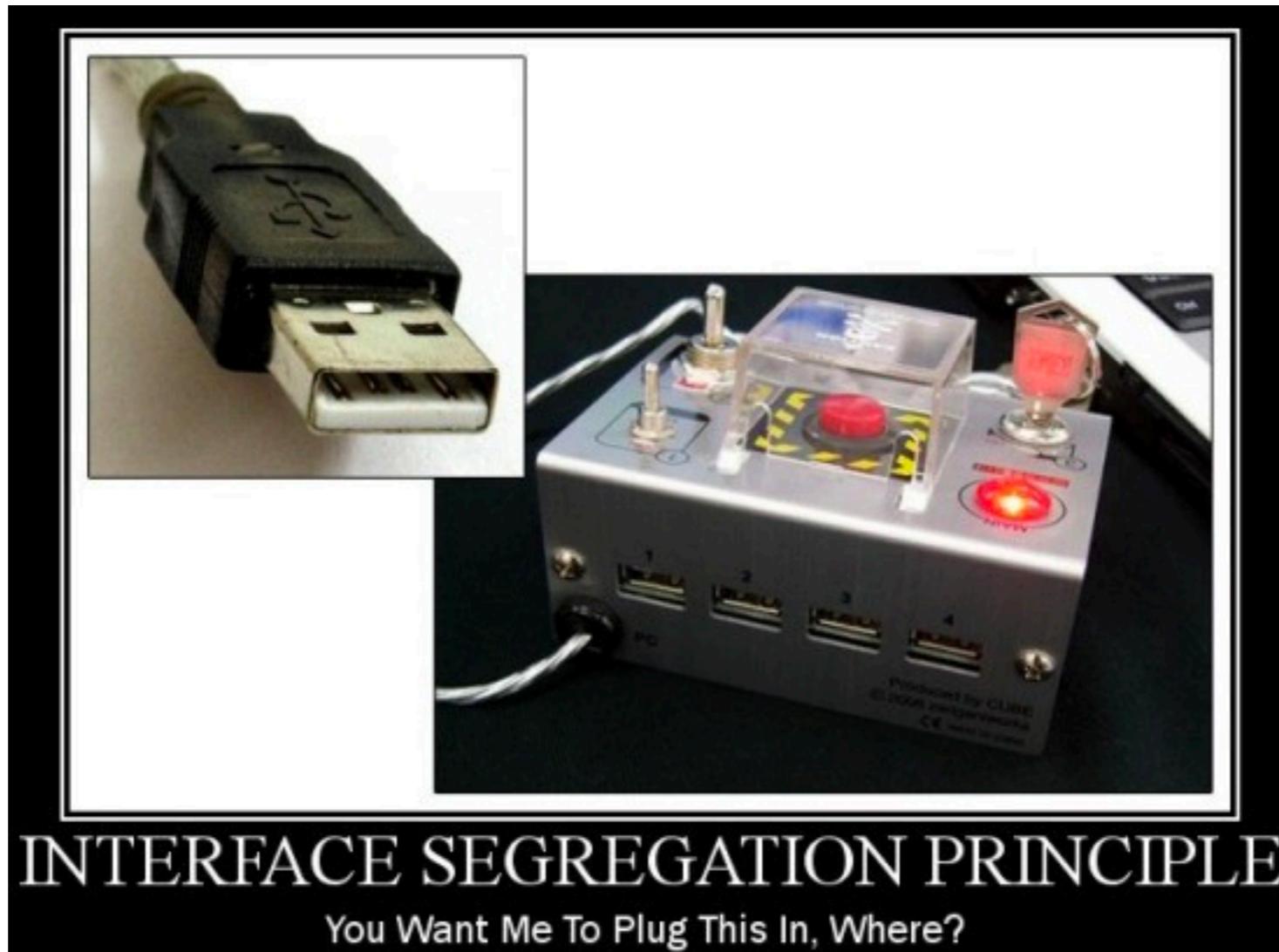
# Liskov Substitution Principle

Child classes should never break the parent



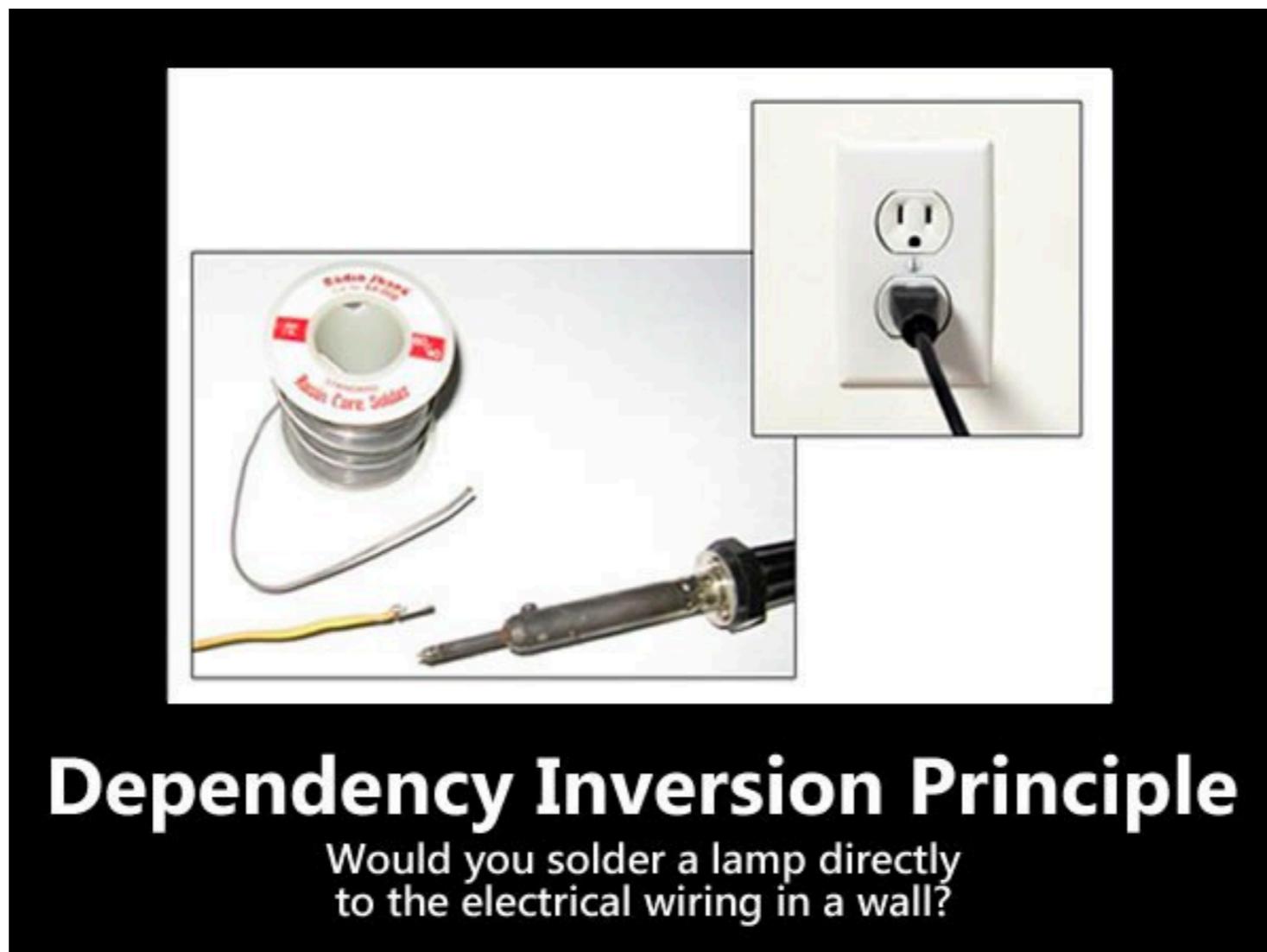
# Interface Segregation Principle

Make fine grained interfaces that are client specific



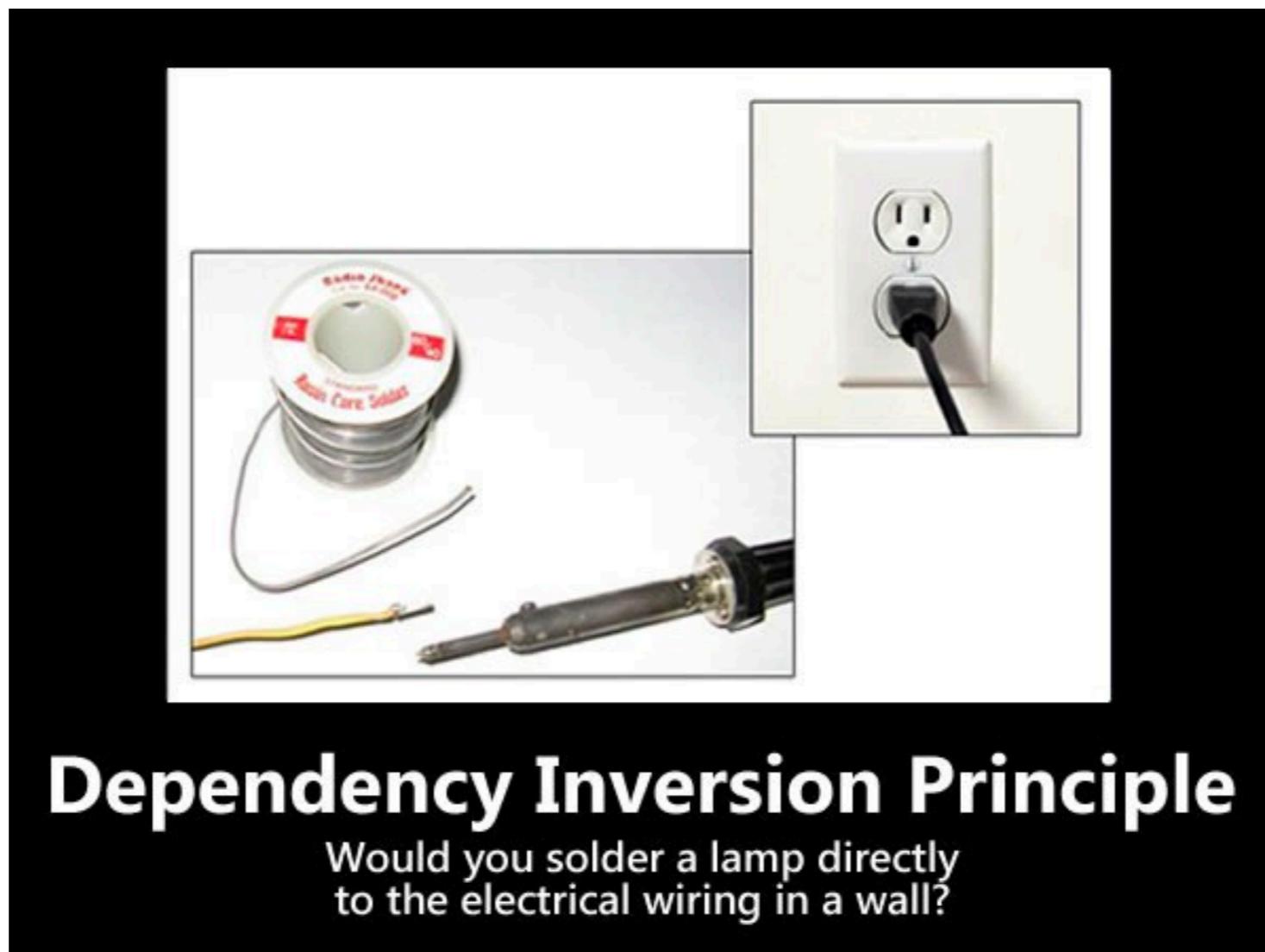
# Dependency Inversion Principle

High-level module should not depend on low-level module

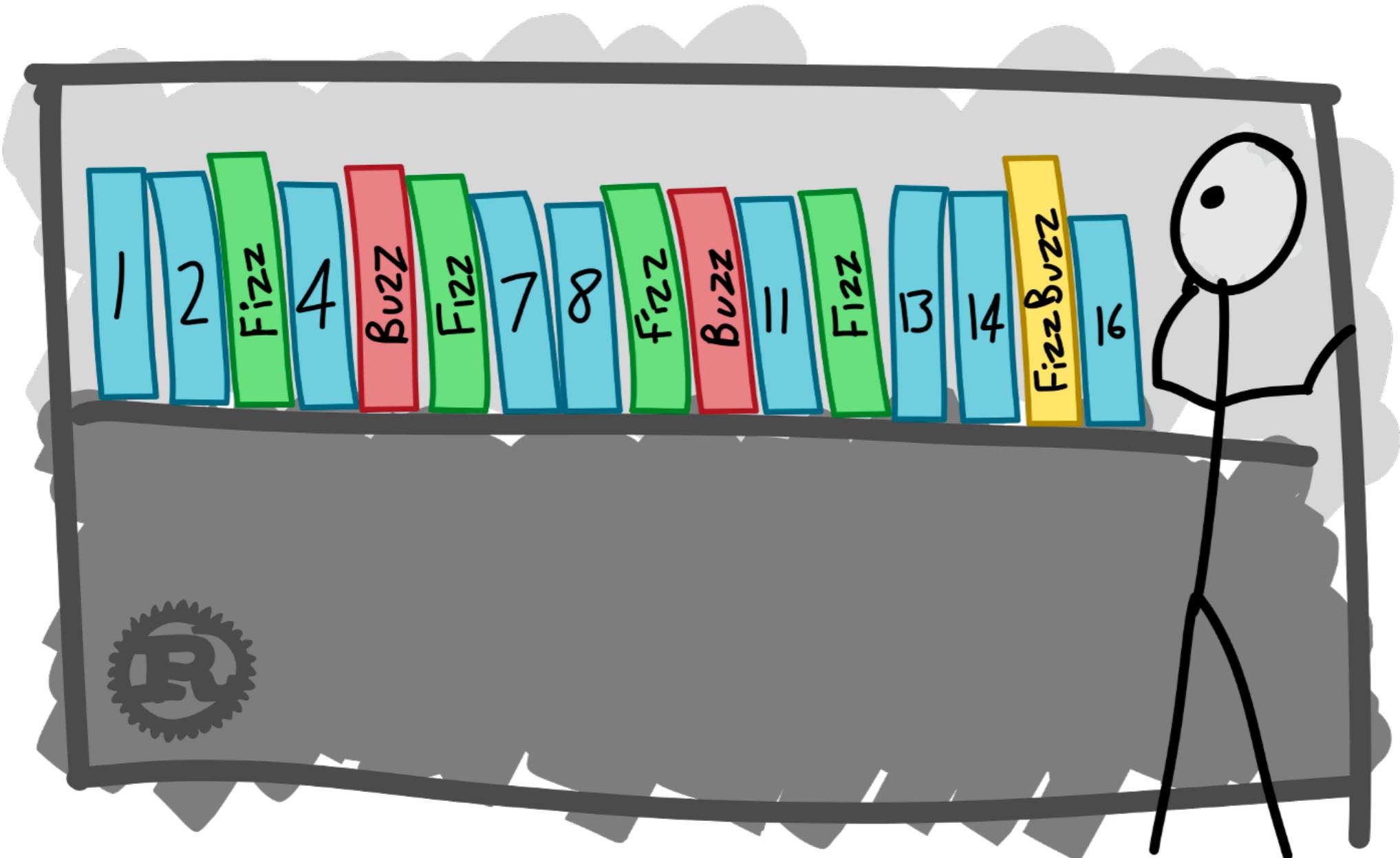


# Dependency Inversion Principle

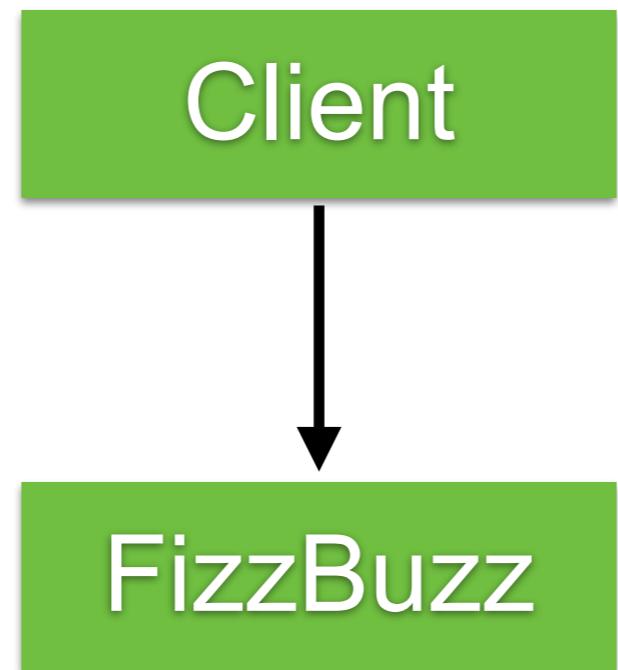
Abstraction layer should not depend on detail



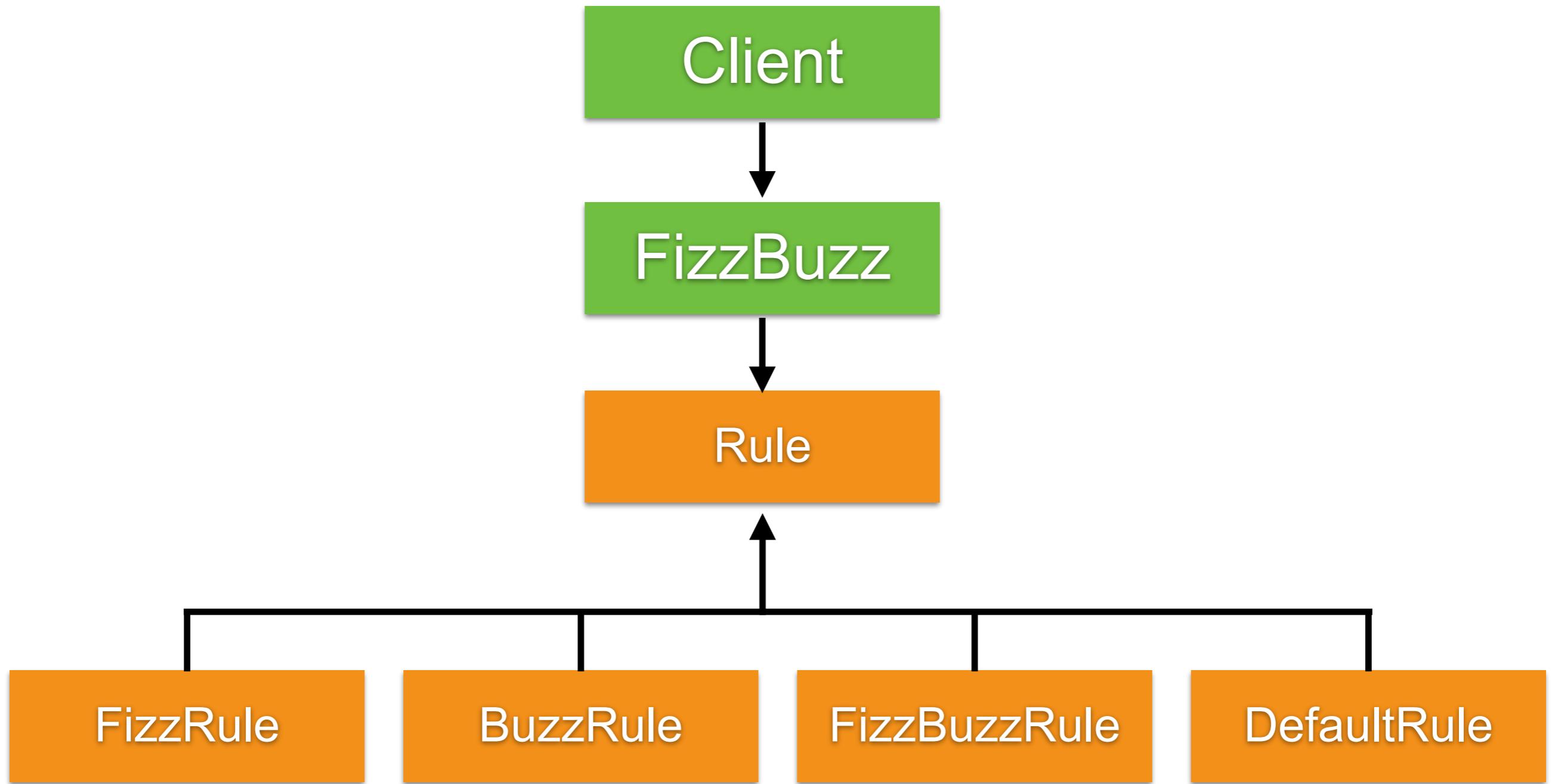
# Workshop



# FizzBuzz



# FizzBuzz



# Code Smell



# Code Smell

## Code Smells

- What? How can code "smell"??
- Well it doesn't have a nose... but it definitely can stink!



### Bloaters

Bloaters are code, methods and classes that have increased to such gargantuan proportions that they are hard to work with. Usually these smells do not crop up right away, rather they accumulate over time as the program evolves (and especially when nobody makes an effort to eradicate them).

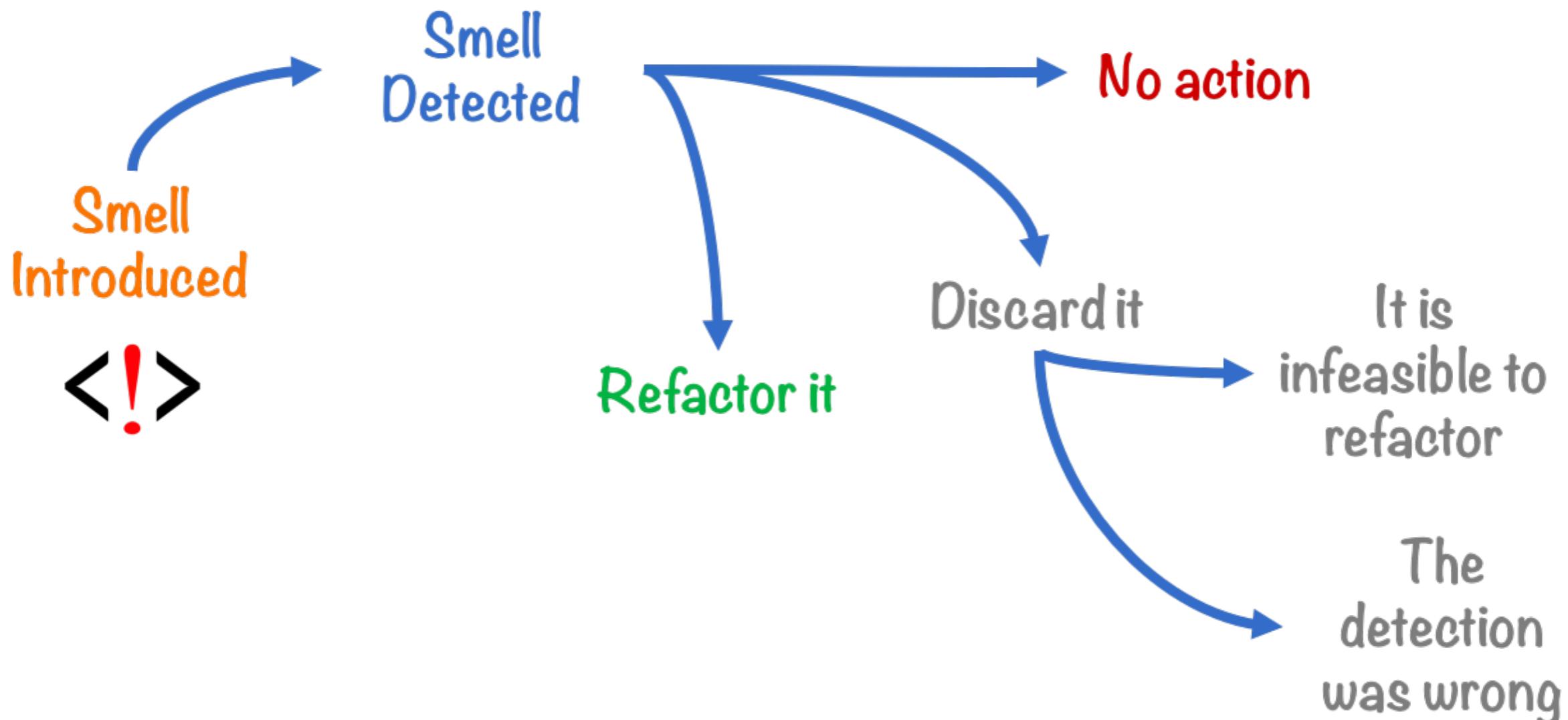
- Long Method
- Large Class
- Primitive Obsession

- Long Parameter List
- Data Clumps

<https://sourcemaking.com/refactoring/smells>



# Code Smell



# Spring Boot



# Spring Framework



# Spring Boot



# REST



# **REST**

**RE**presentation **S**tate **T**ransfer

The style of software architecture behind  
**RESTful** services

Defined in 2000 by Roy Fielding

[https://www.ics.uci.edu/~fielding/pubs/dissertation/rest\\_arch\\_style.htm](https://www.ics.uci.edu/~fielding/pubs/dissertation/rest_arch_style.htm)



# Goals

Scalability

Generality of interfaces

Independent deployment of components



# **RESTful service**



# REST Request Messages

RESTful request is typically in form of  
**Uniform Resource Identifiers (URI)**



# REST Request Messages

RESTful request is typically in form of  
**Uniform Resource Identifiers (URI)**

Structure of URI depend on specific service



# REST Request Messages

RESTful request is typically in form of  
**Uniform Resource Identifiers (URI)**

Structure of URI depend on specific service

Request can include parameter and data in  
body of request as XML, JSON etc.



# REST Request & Response

**Request Method**

GET, POST, PUT, DELETE

Client

Server



**Response Format**

XML or JSON



# HTTP Methods meaning

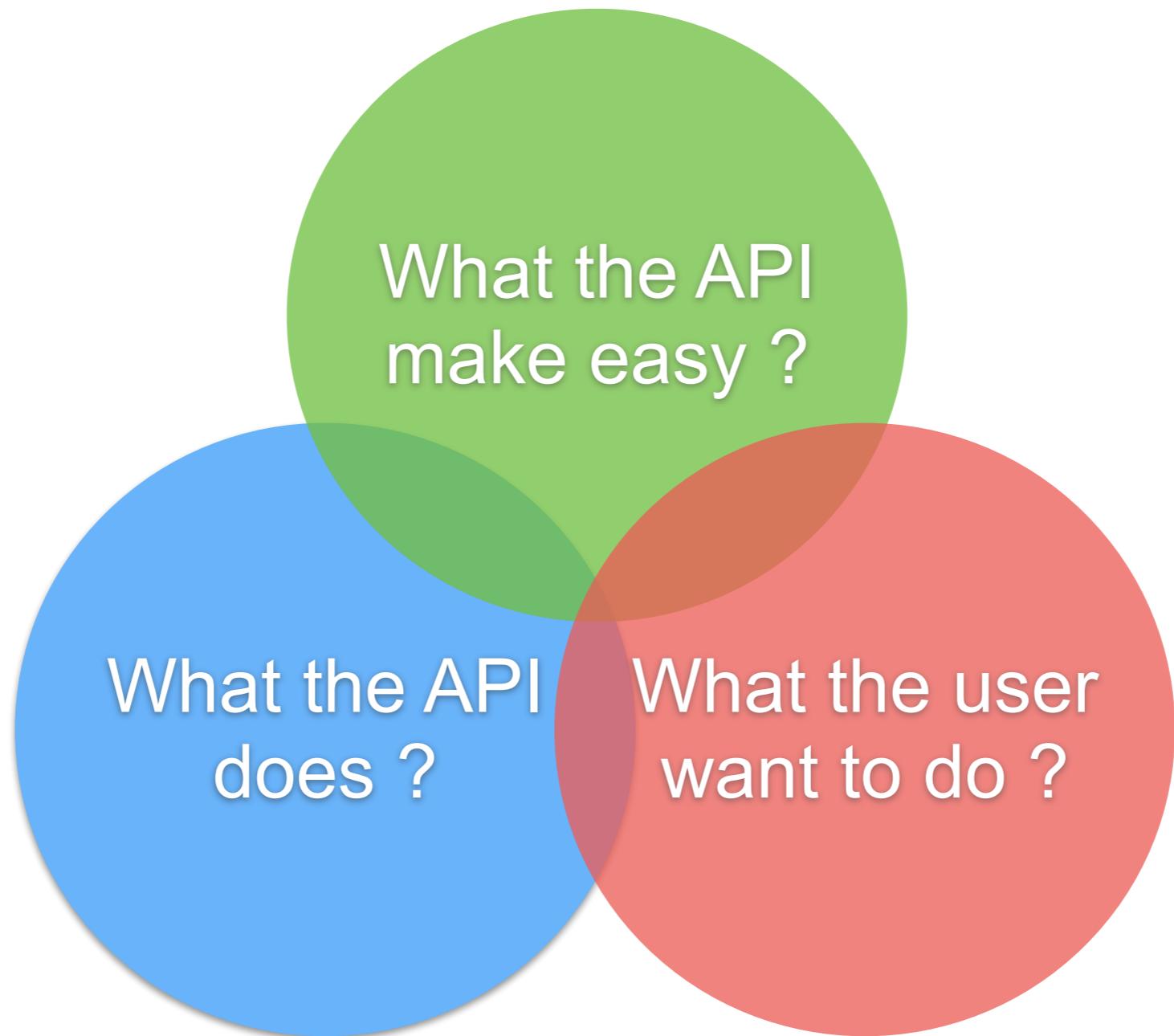
Method	Meaning
GET	Read data
POST	Create/Insert new data
PUT/PATCH	Update data or insert if a new id
DELETE	Delete data



# Response format ?



# Good APIs ?



# Java Framework for RESTful



## unirest

Lightweight HTTP Request Client Libraries



## Spark



## Dropwizard



## Restlet



## ACT.framework



Spring Framework

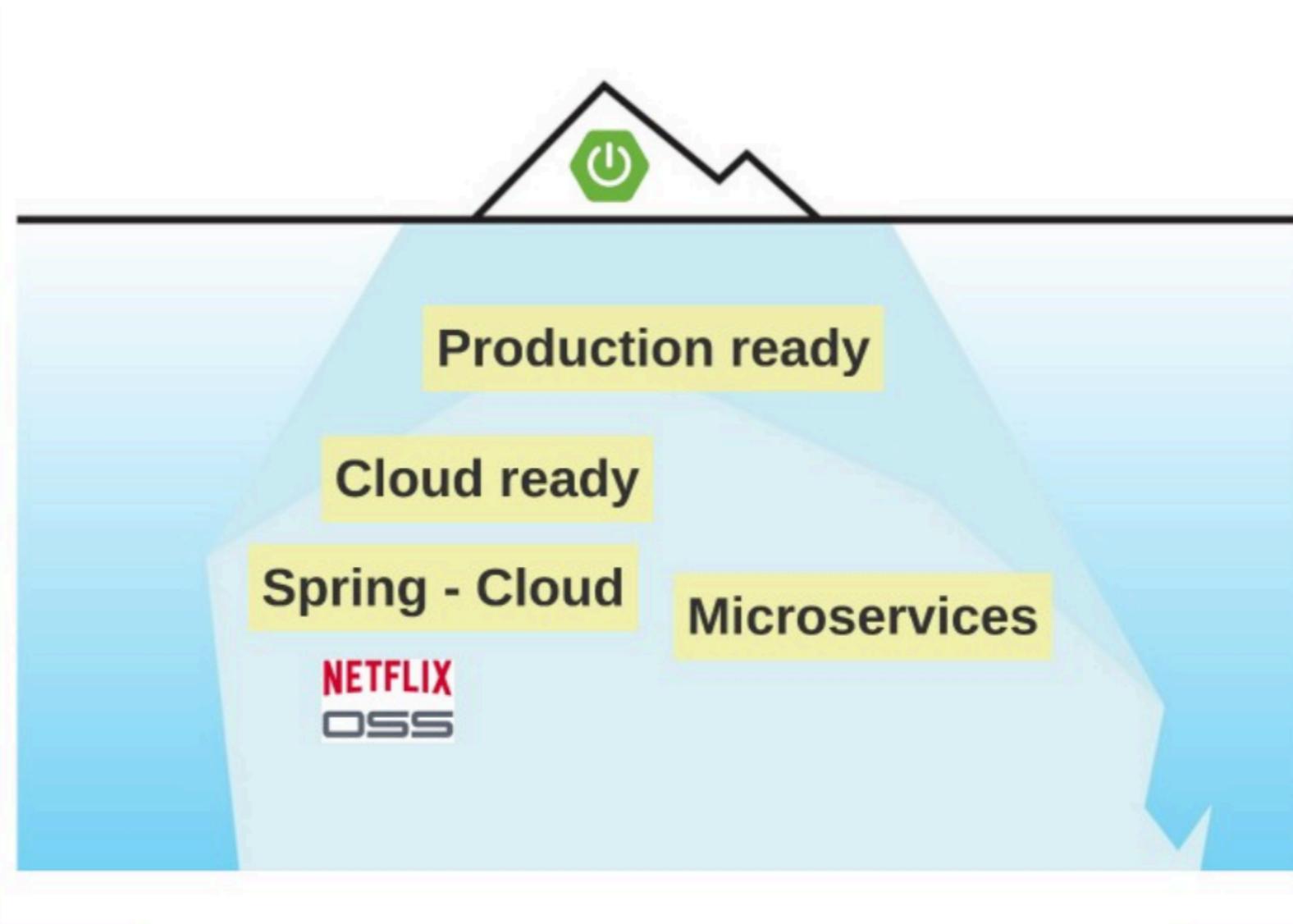
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# Hello Spring Boot



# Why ?

Application skeleton generator  
Reduce effort to add new technologies



# What ?

Embedded application server

Integration with tools/technologies (starter)

Production tools (monitoring, health check)

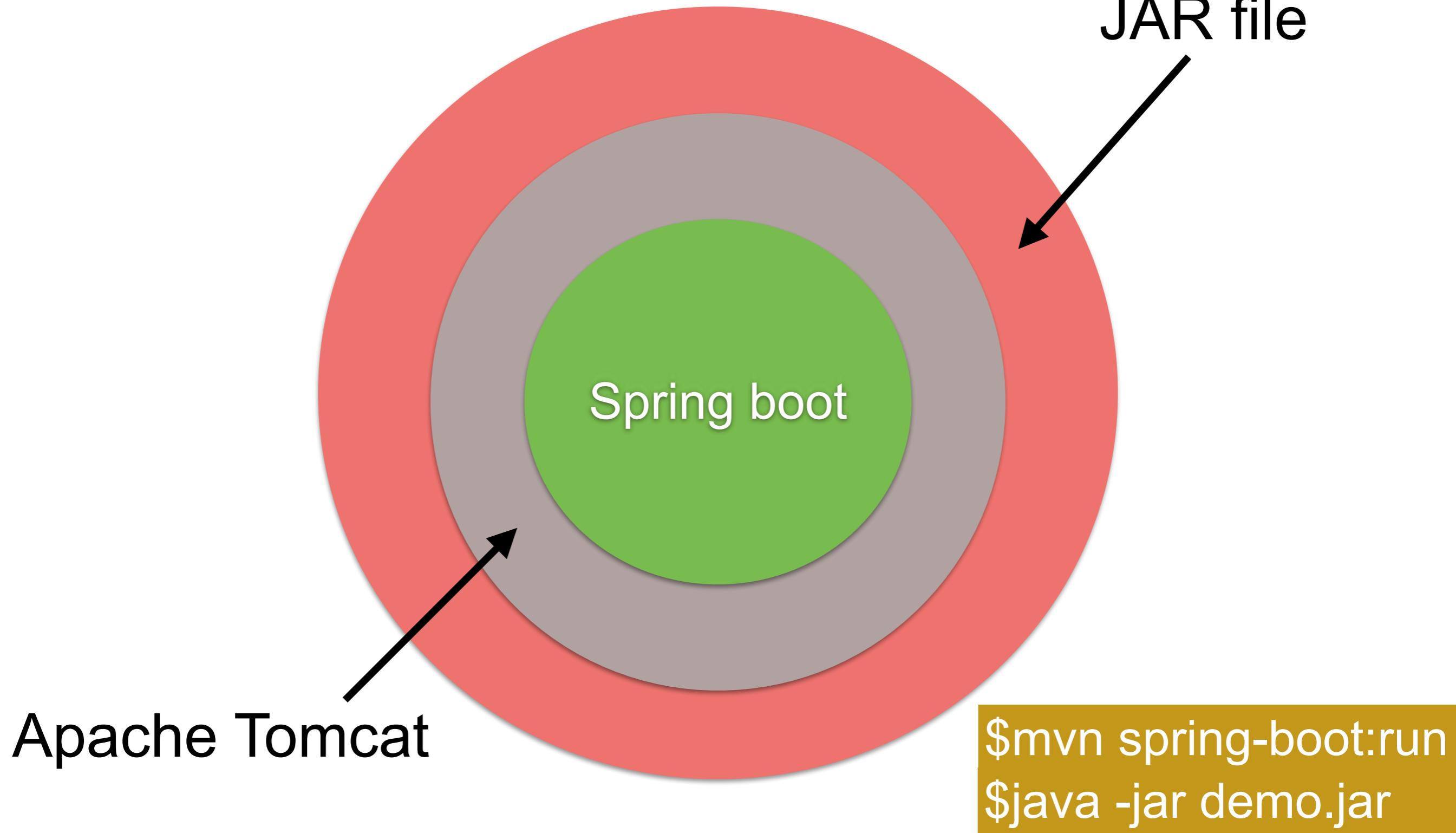
Configuration management

Dev tools

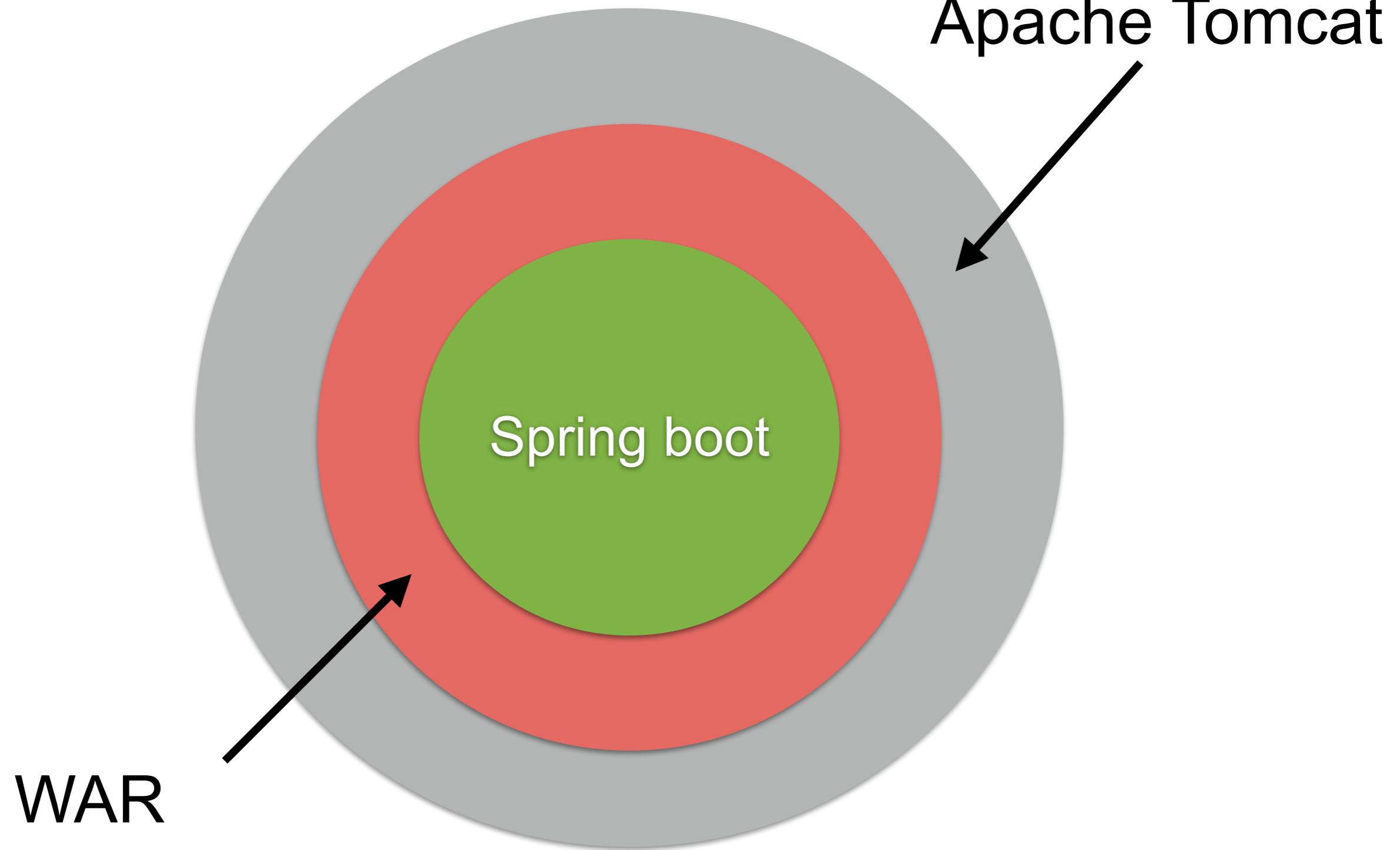
No source code generation, no XML



# How ?



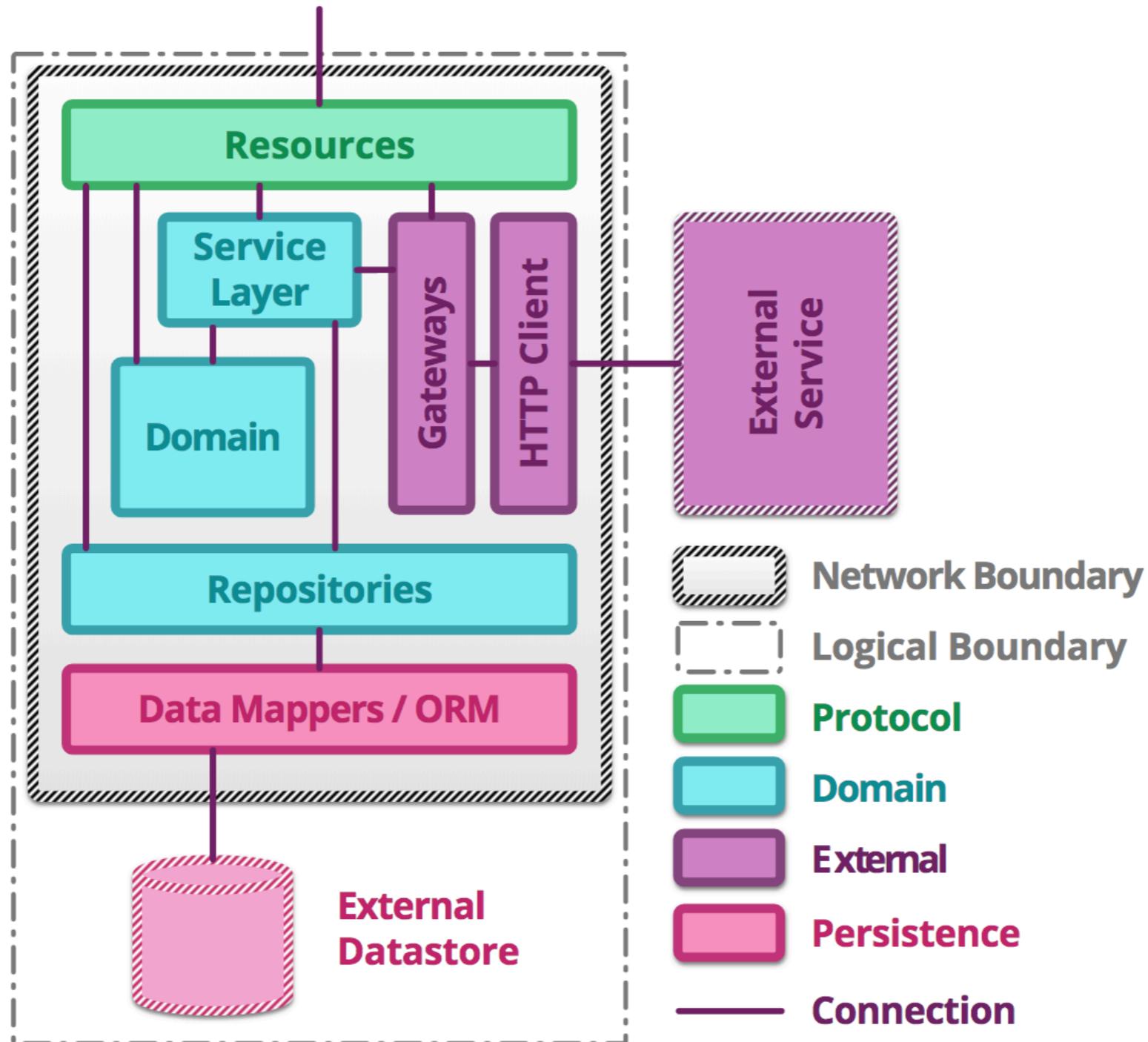
# How ?



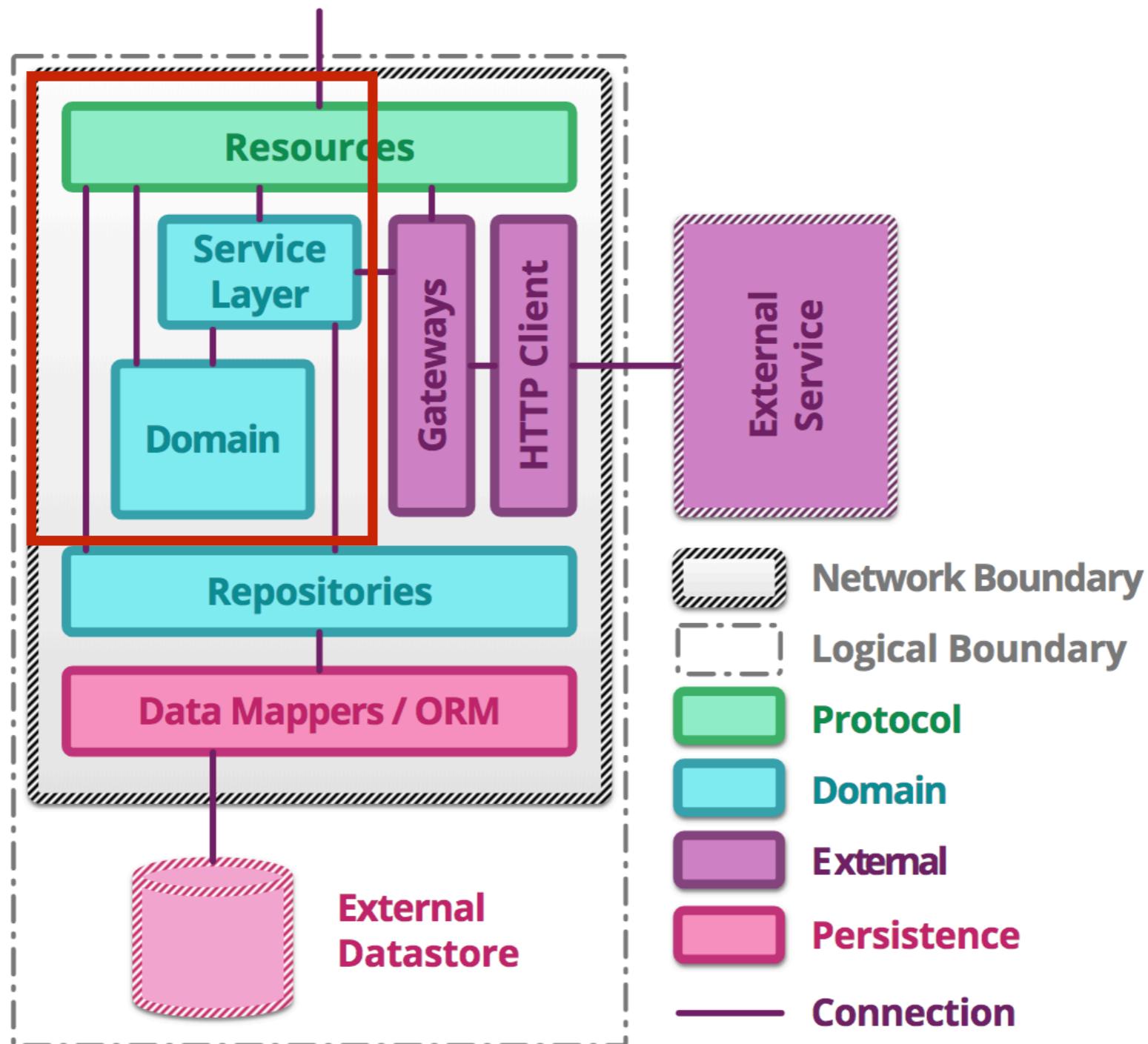
# **Building RESTful API with Spring Boot**



# Service Structure



# Service Structure



# Create project with Spring Initializr



# Spring Initializr

<https://start.spring.io/>

The screenshot shows the Spring Initializr web application interface. At the top left is the logo. Below it, there are sections for Project type (Maven Project selected), Language (Java selected), and Spring Boot version (2.4.1 selected). The Project Metadata section includes fields for Group (com.example), Artifact (demo), Name (demo), Description (Demo project for Spring Boot), Package name (com.example.demo), Packaging (Jar selected), and Java version (11 selected). On the right side, there is a large 'Dependencies' section with a button to 'ADD DEPENDENCIES...'.

**Project**

Maven Project  Gradle Project

**Language**

Java  Kotlin  Groovy

**Spring Boot**

2.5.0 (SNAPSHOT)  2.4.2 (SNAPSHOT)  2.4.1  2.3.8 (SNAPSHOT)  
 2.3.7

**Project Metadata**

Group: com.example

Artifact: demo

Name: demo

Description: Demo project for Spring Boot

Package name: com.example.demo

Packaging:  Jar  War

Java:  15  11  8

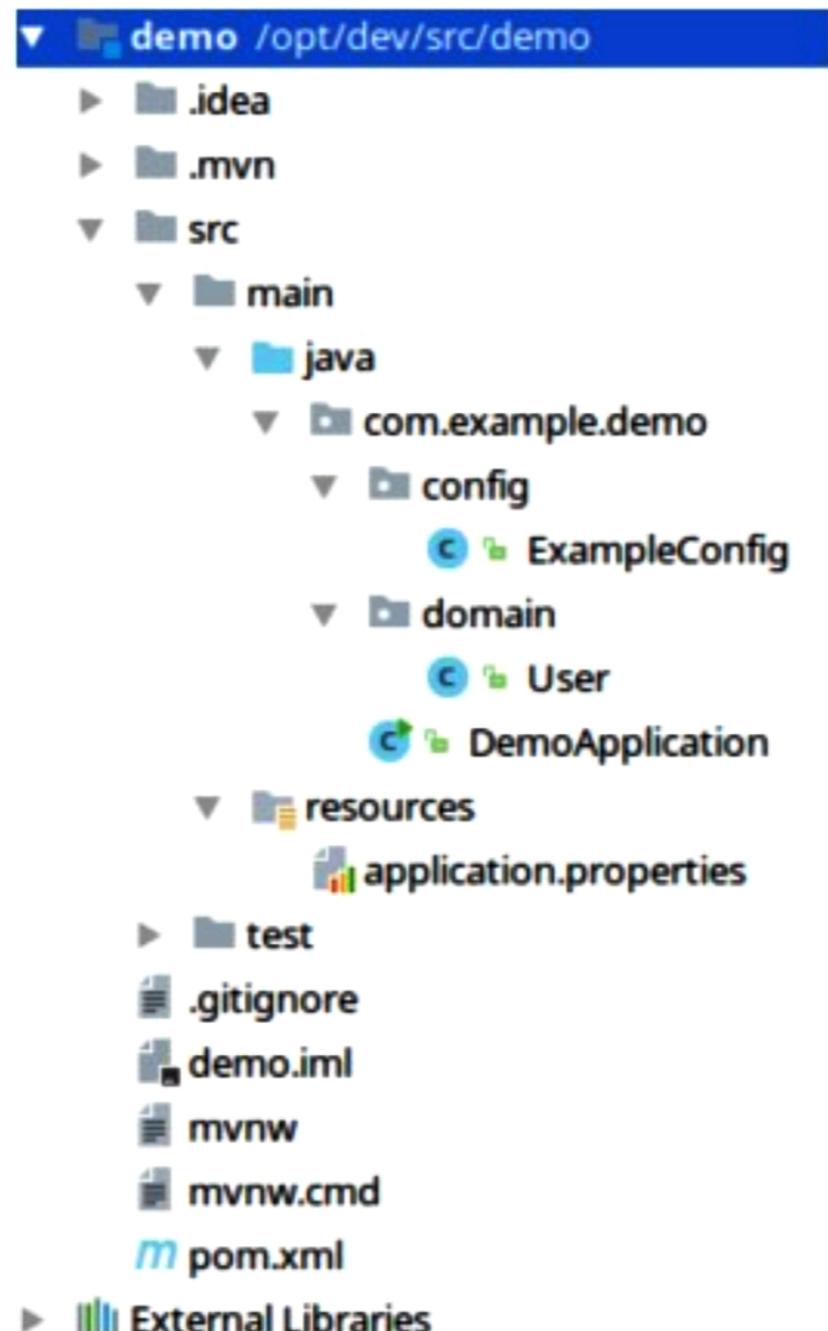
**Dependencies**

No dependency selected

**ADD DEPENDENCIES... ⌘ + B**



# Structure of Spring Boot



# Spring Boot main class

```
package com.example.demo;

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

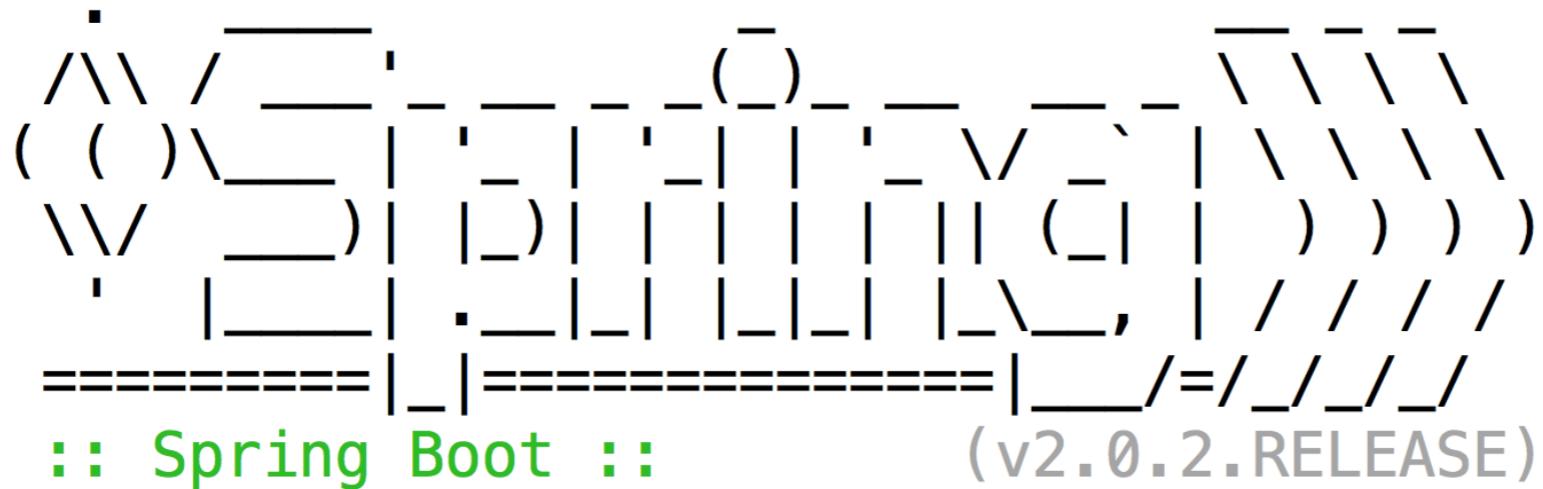
@SpringBootApplication
public class DemoApplication {

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



# Run project (Dev mode)

```
./mvnw spring-boot:run
```

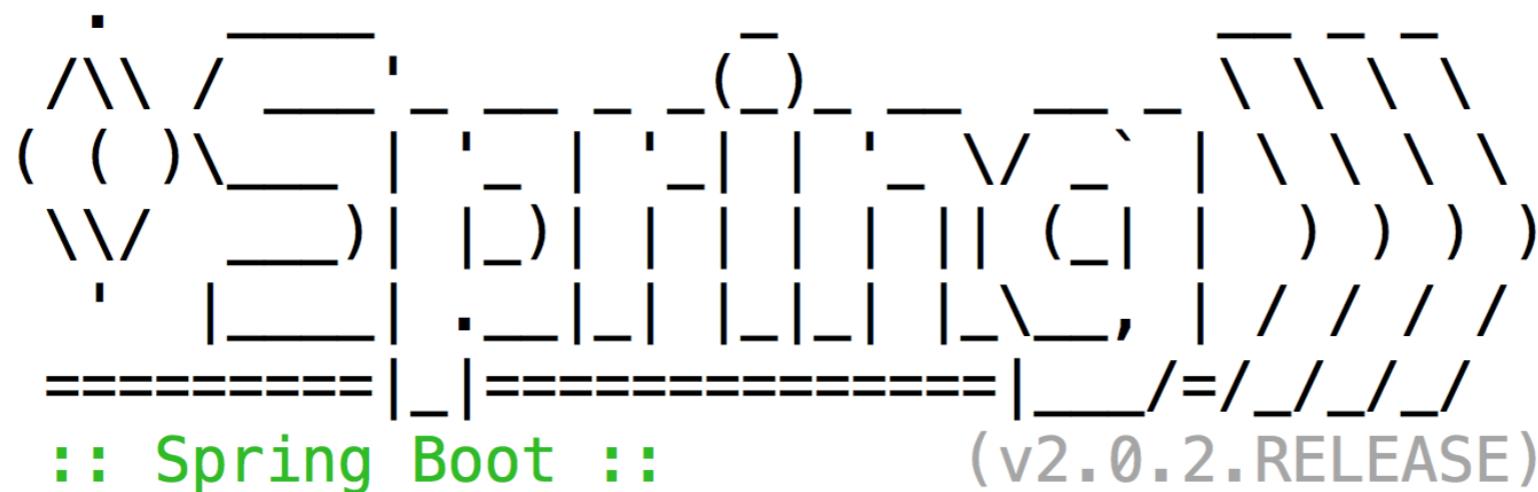


```
2018-06-07 13:03:30.412  INFO 12828 --- [  
  oApplication           : Starting DemoApplication on  
D 12828 (started by somkiat in /Users/somkiat/Down  
2018-06-07 13:03:30.418  INFO 12828 --- [  
  oApplication           : No active profile set, fall
```



# Run project (production mode)

```
$./mvnw package  
$java -jar target/<file name>.jar
```



```
2018-06-07 13:03:30.412  INFO 12828 --- [  
  oApplication           : Starting DemoApplication on  
D 12828 (started by somkiat in /Users/somkiat/Down  
2018-06-07 13:03:30.418  INFO 12828 --- [  
  oApplication           : No active profile set, fall
```



# Display all beans !!

```
@SpringBootApplication
public class DemoApplication {

    public static void main(String[] args) {
        ApplicationContext context
            = SpringApplication.run(DemoApplication.class,
                System.out.println(name);
            }

    }
}
```



# Custom Banner



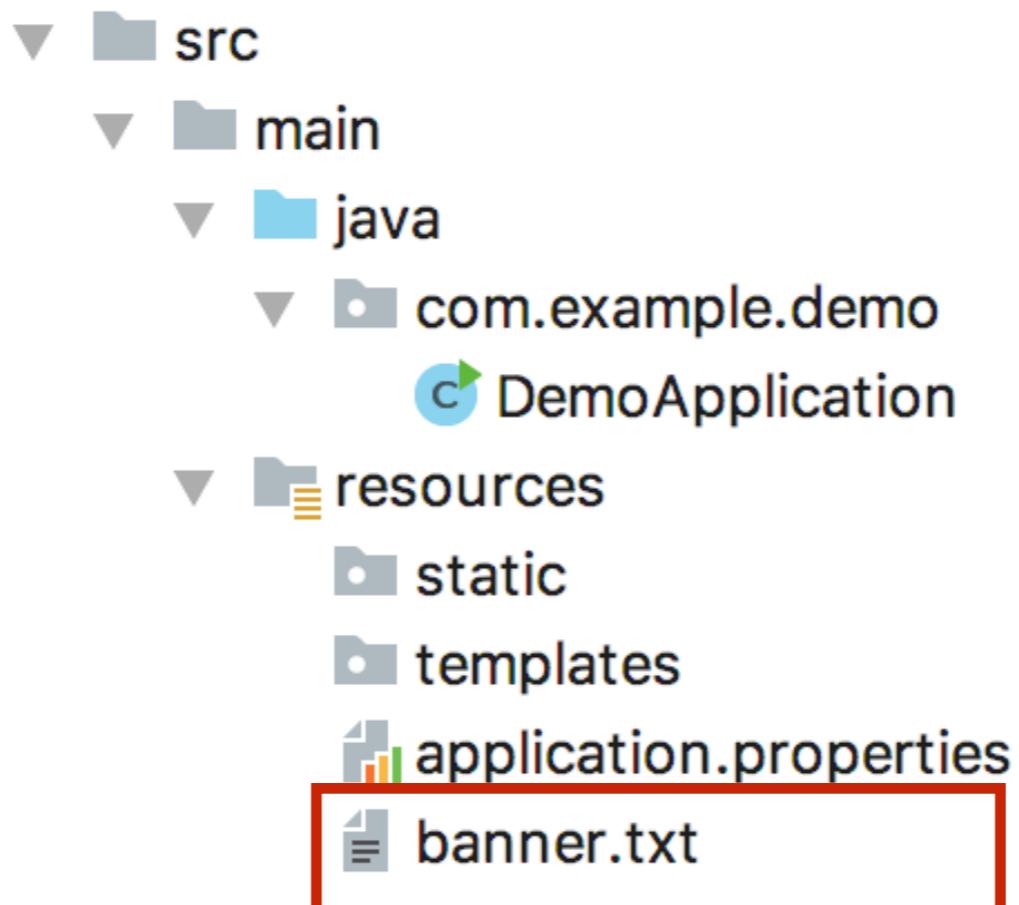
# Custom banner

```
2018-06-07 13:03:30.412  INFO 12828 --- [  
  oApplication : Starting DemoApplication on  
D 12828 (started by somkiat in /Users/somkiat/Down  
2018-06-07 13:03:30.418  INFO 12828 --- [  
  oApplication : No active profile set, fall
```



# Custom banner (1)

Create file banner.txt or banner.png in resources folder



# Custom banner (2)

```
@SpringBootApplication
public class DemoApplication {

    public static void main(String[] args) {
        ImageBanner banner = new ImageBanner(
            new ClassPathResource("try.png"));

        new SpringApplicationBuilder()
            .sources(DemoApplication.class)
            .banner(banner)
            .run();
    }
}
```



# Disable banner

```
@SpringBootApplication
public class DemoApplication {

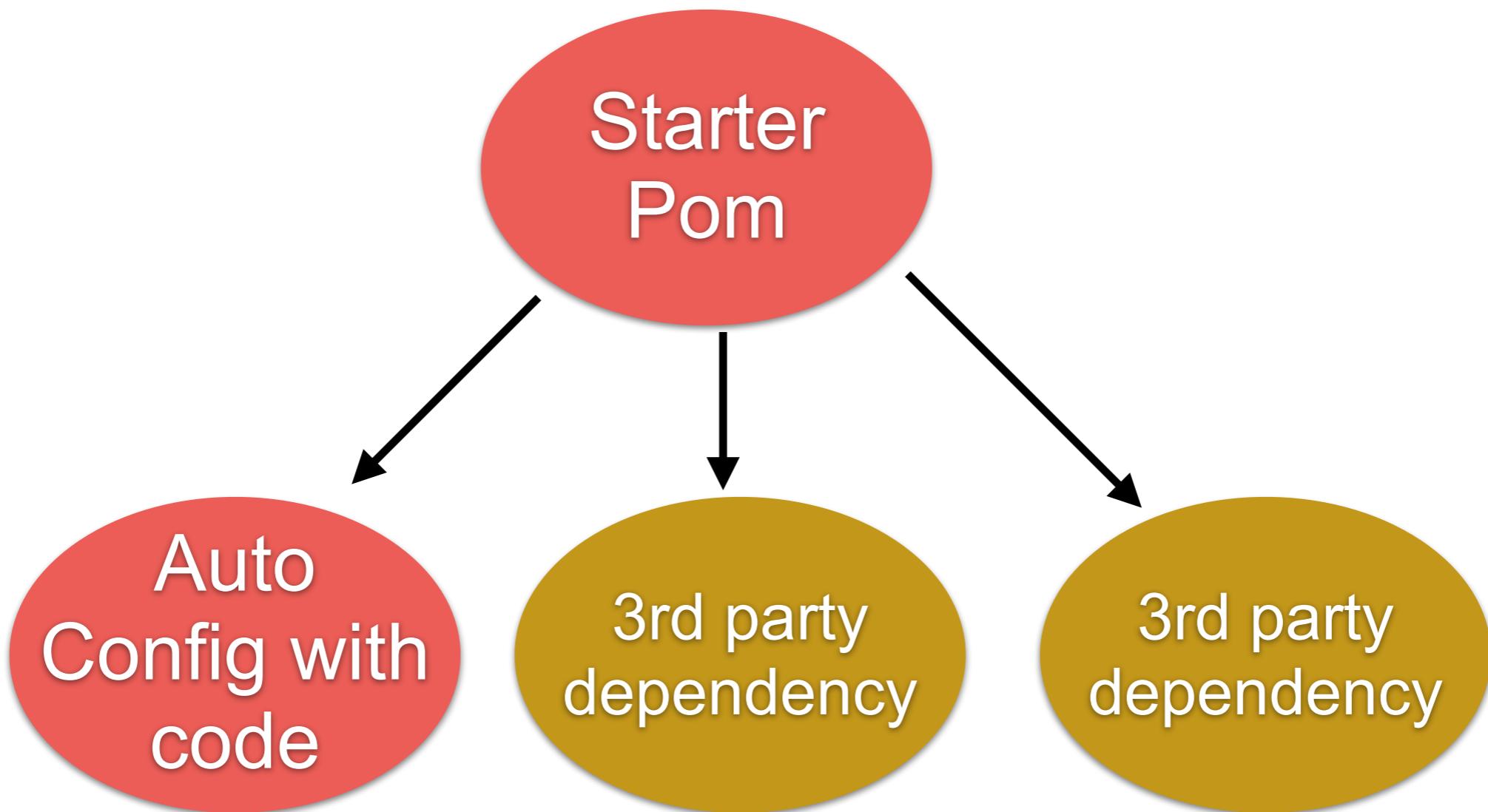
    public static void main(String[] args) {
        new SpringApplicationBuilder()
            .sources(DemoApplication.class)
            .bannerMode(Banner.Mode.OFF)
            .run(args);
    }
}
```



# Anatomy of Starter



# Anatomy of Starter



# Configuration management

Properties/XML/YAML

Config server (App, Spring cloud config, git)

17 ways !!!

<https://docs.spring.io/spring-boot/docs/current/reference/html/boot-features-external-config.html>



# Look at POM.xml



# POM.xml (1)

```
<project xmlns="http://maven.apache.org/POM/4.0.0"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://maven.apache.org/POM/4.0.0 http://maven.apache.org/xsd/maven-4.0.0.xsd">
<modelVersion>4.0.0</modelVersion>

<groupId>hello</groupId>
<artifactId>hello</artifactId>
<version>1.0-SNAPSHOT</version>
<packaging>jar</packaging>

<parent>
    <groupId>org.springframework.boot</groupId>
    <artifactId>spring-boot-starter-parent</artifactId>
    <version>2.0.0.RELEASE</version>
    <relativePath/> 
</parent>

<properties>
    <project.build.sourceEncoding>UTF-8</project.build.sourceEncoding>
    <project.reporting.outputEncoding>UTF-8</project.reporting.outputEncoding>
    <java.version>1.8</java.version>
</properties>
```



# POM.xml (2)

```
<dependencies>
    <dependency>
        <groupId>org.springframework.boot</groupId>
        <artifactId>spring-boot-starter-web</artifactId>
    </dependency>

    <dependency>
        <groupId>org.springframework.boot</groupId>
        <artifactId>spring-boot-starter-test</artifactId>
        <scope>test</scope>
    </dependency>
</dependencies>

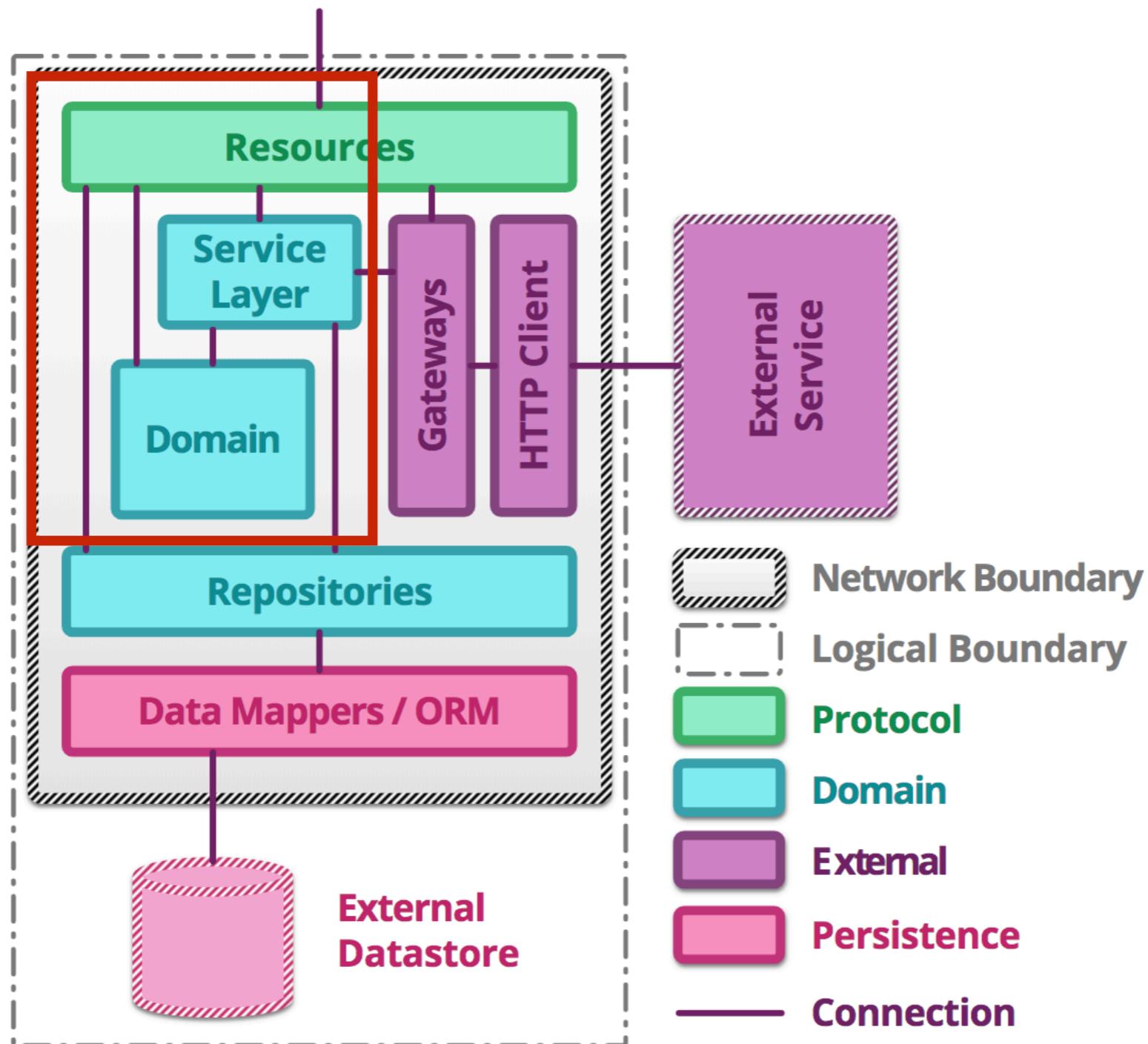
<build>
    <finalName>hello</finalName>
    <plugins>
        <plugin>
            <groupId>org.springframework.boot</groupId>
            <artifactId>spring-boot-maven-plugin</artifactId>
        </plugin>
    </plugins>
</build>
```



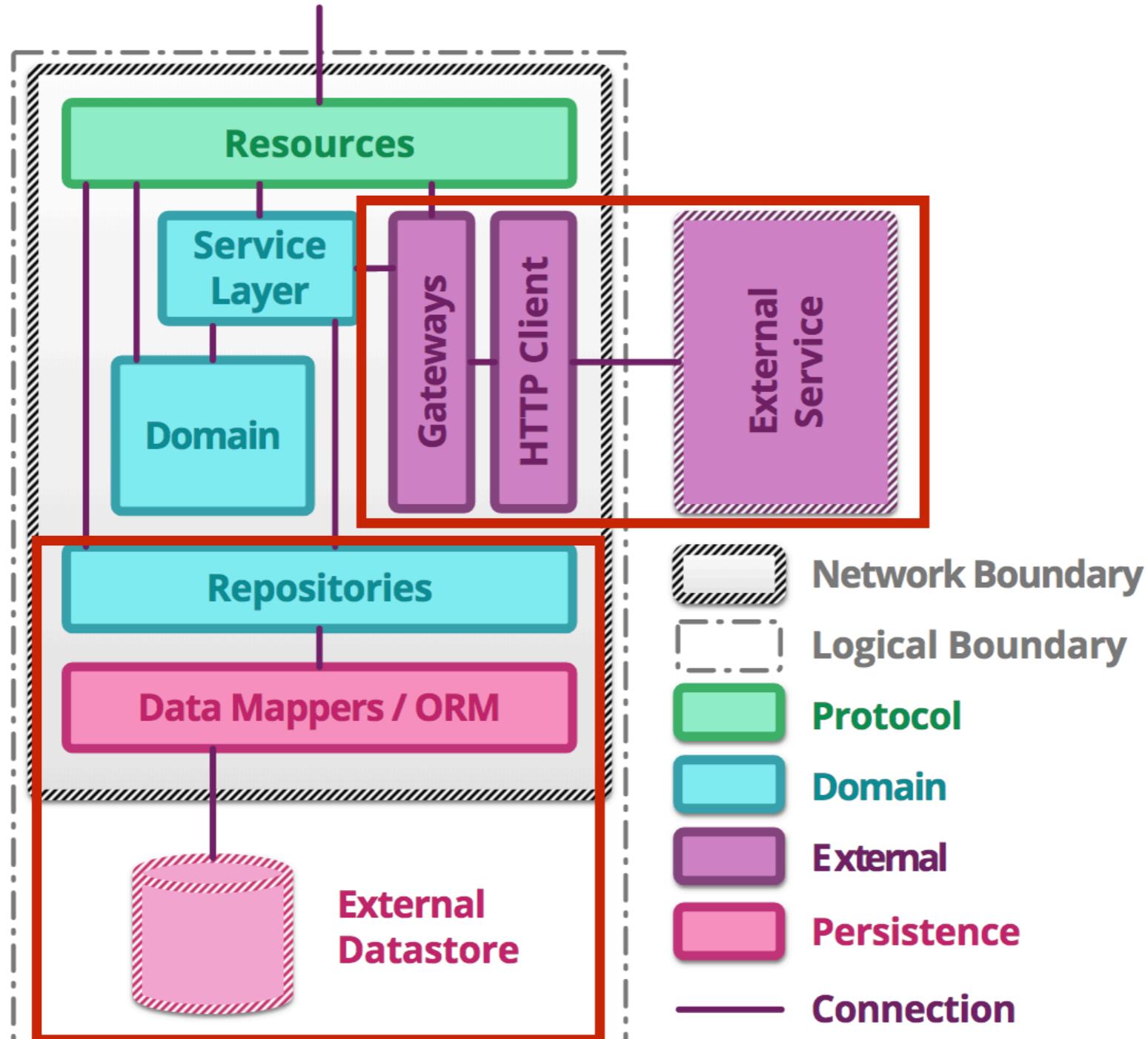
# Basic structure of Spring Boot



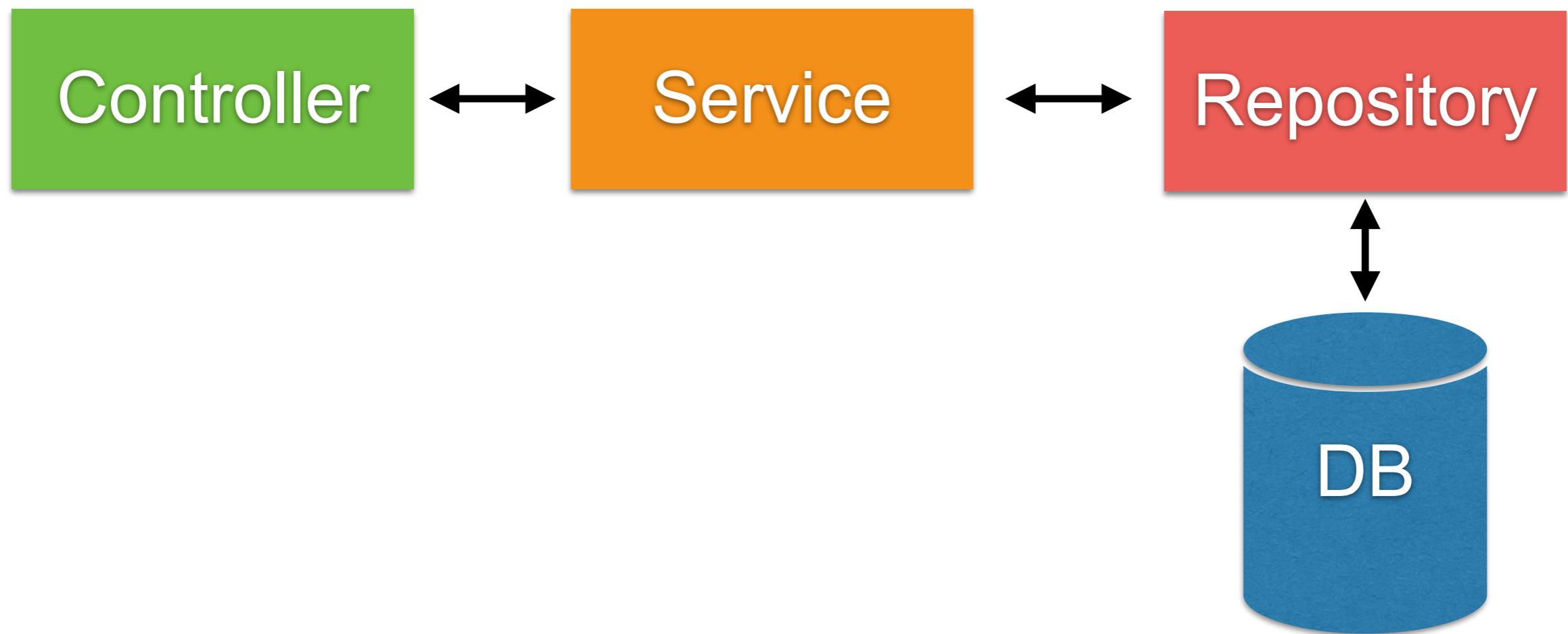
# Service Structure



# Service Structure



# Basic structure of Spring Boot



# Controller

Request and Response  
Validation input

Delegate to others classes such as service and repository



# Service

Control the flow of main business logic  
Manage database transaction  
Don't reuse service



# Repository

Manage data in data store such as RDBMS and  
NoSQL



# Gateway

Call external service via network such as  
WebServices and RESTful APIs



# Spring Boot Structure (1)

Separate by function/domain/feature

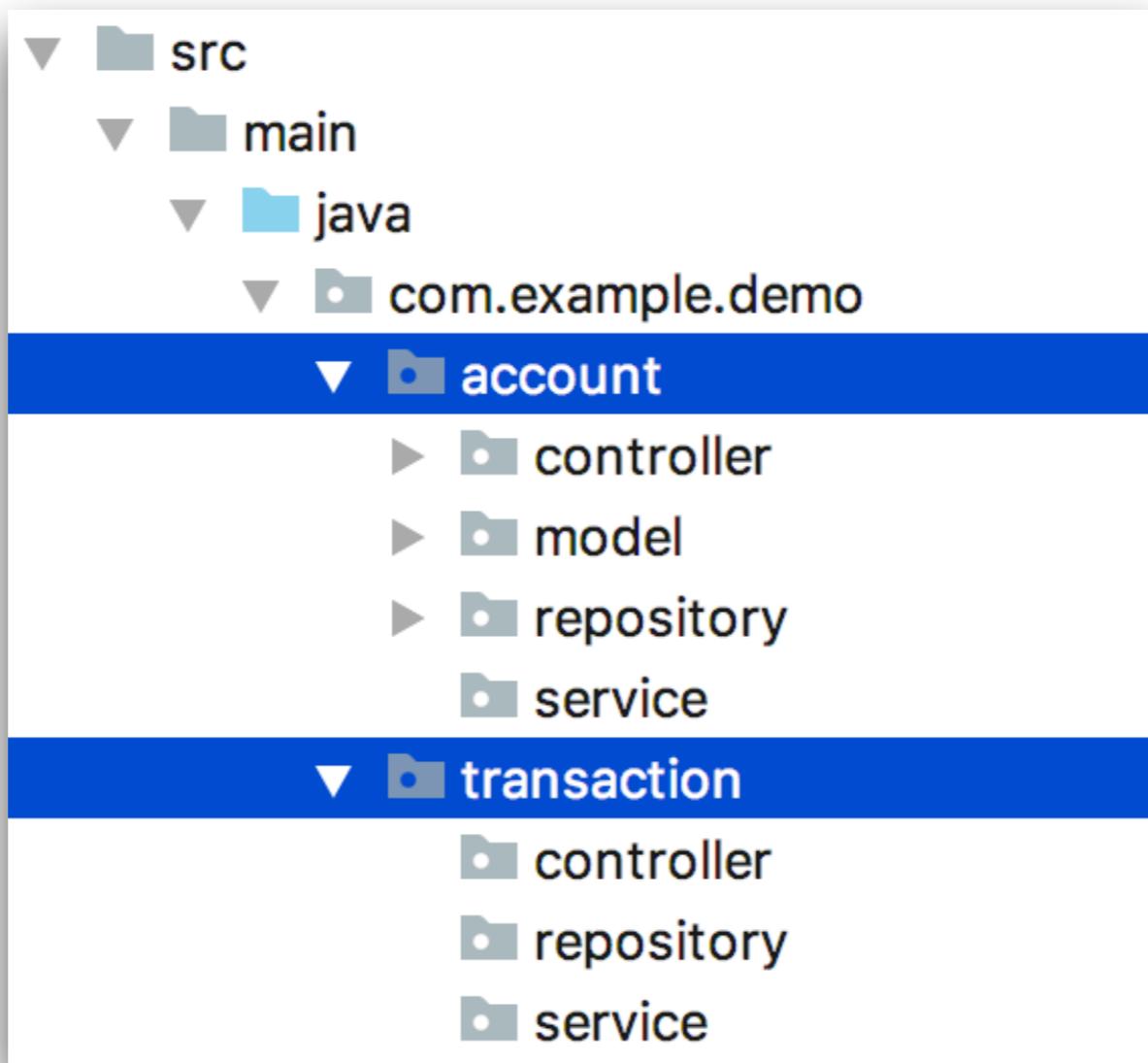
- feature1**
  - controller
  - service
  - repository
- feature2**
  - controller
  - service
  - repository

<https://docs.spring.io/spring-boot/docs/current/reference/html/using-boot-structuring-your-code.html>



# Spring Boot Structure (2)

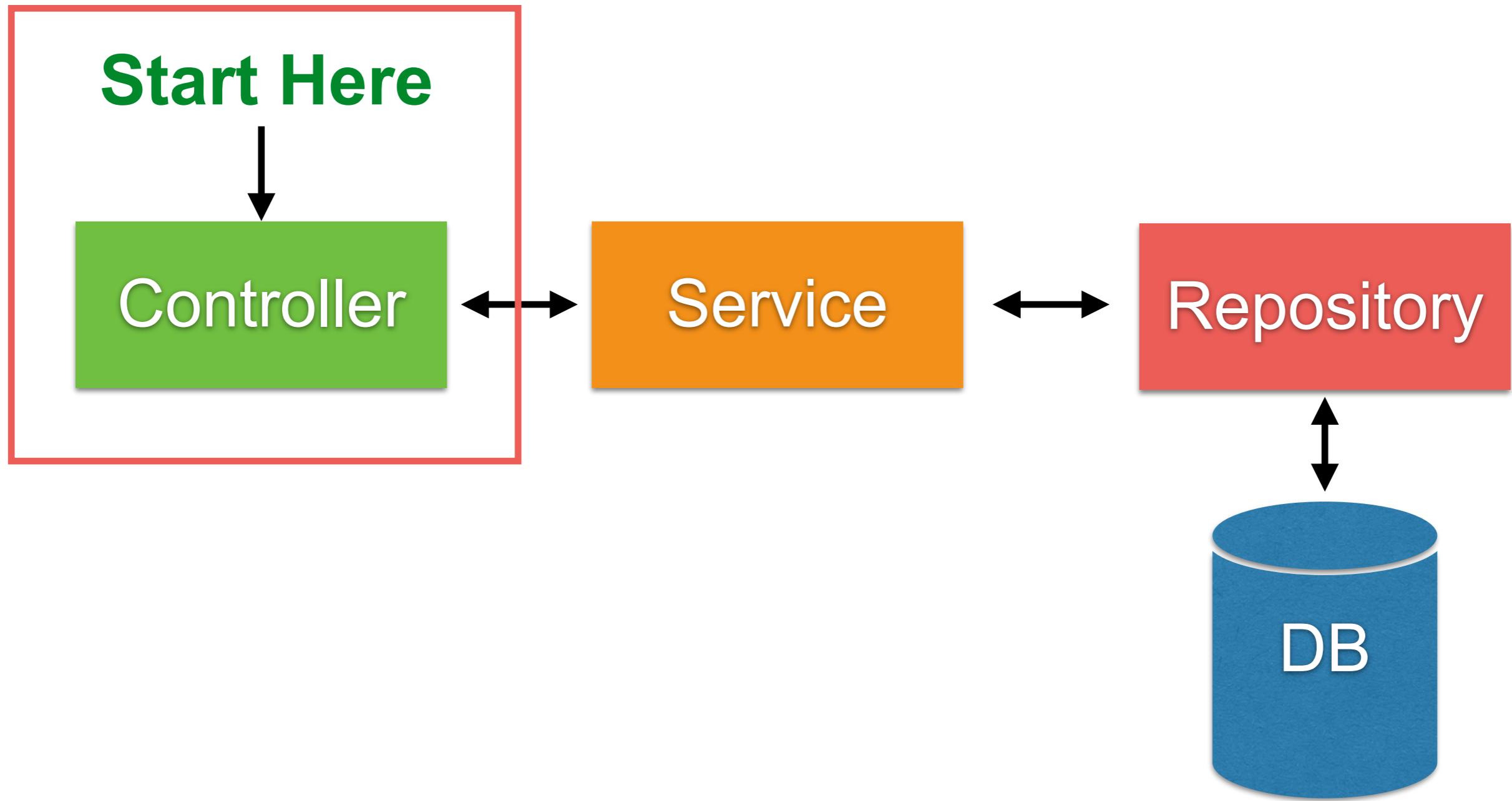
Separate by function/domain/feature



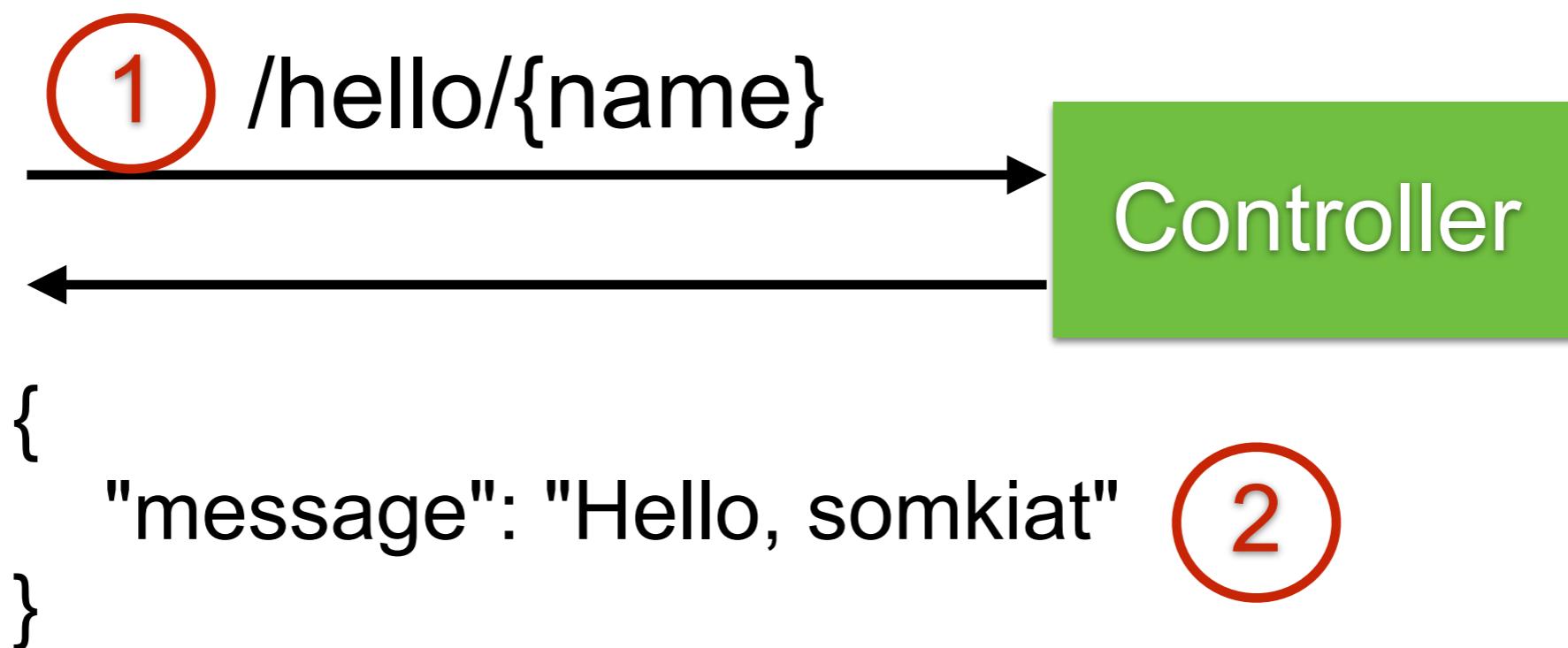
# Create first RESTful API



# Basic structure of Spring Boot



# Hello API



# 1. Create REST Controller

## HelloController.java

```
@RestController
public class HelloController {

    @GetMapping("/hello/{name}")
    public Hello sayHi(@PathVariable String name) {
        return new Hello("Hello, " + name);
    }

}
```



# 2. Create model class

## Hello.java

```
public class Hello {  
  
    private String message;  
  
    Hello(String message) {  
        this.message = message;  
    }  
  
    public String getMessage() {  
        return message;  
    }  
  
    public void setMessage(String message) {  
        this.message = message;  
    }  
}
```



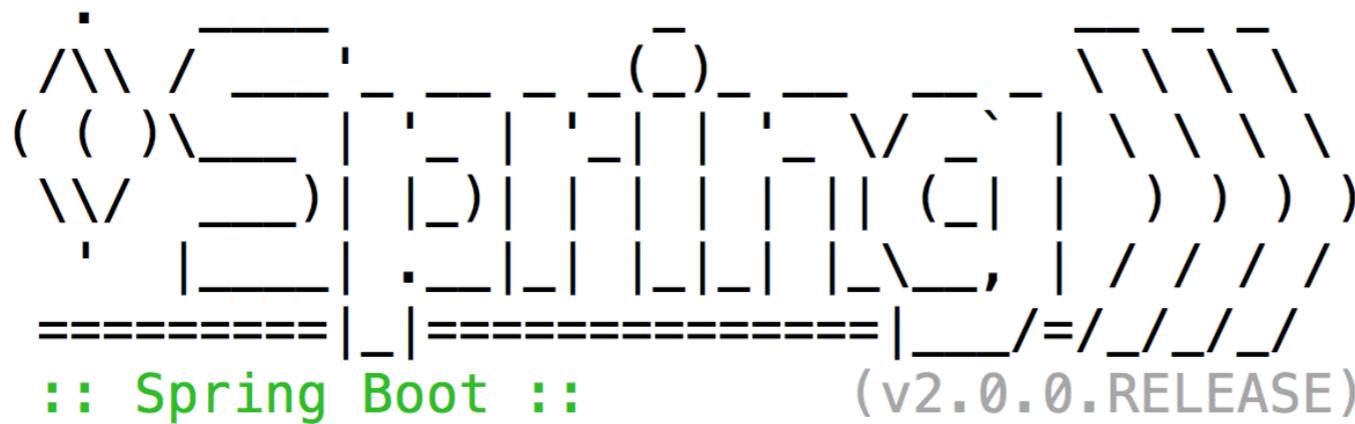
# 3. Compile and Packaging

\$mvnw clean package



# 4. Run

```
$java -jar target/hello.jar
```

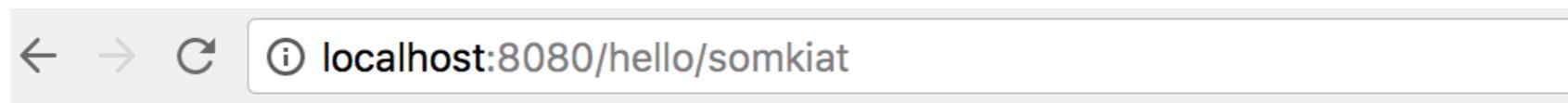


```
2018-03-05 23:37:18.018 INFO 30560 --- [           mair
          : Starting HelloApplication v1.0-SNAPSHOT
PID 30560 (/Users/somkiat/data/slide/microservice/sl
op/course-microservice/slides/4days-workshop/workshop/he
by somkiat in /Users/somkiat/data/slide/microservice/sl
hop/course-microservice/slides/4days-workshop/workshop/he
2018-03-05 23:37:18.023 INFO 30560 --- [           mair
          : No active profile set, falling back to
2018-03-05 23:37:18.138 INFO 30560 --- [           mair
```



# 5. Open in browser

<http://localhost:8080/hello/somkiat>

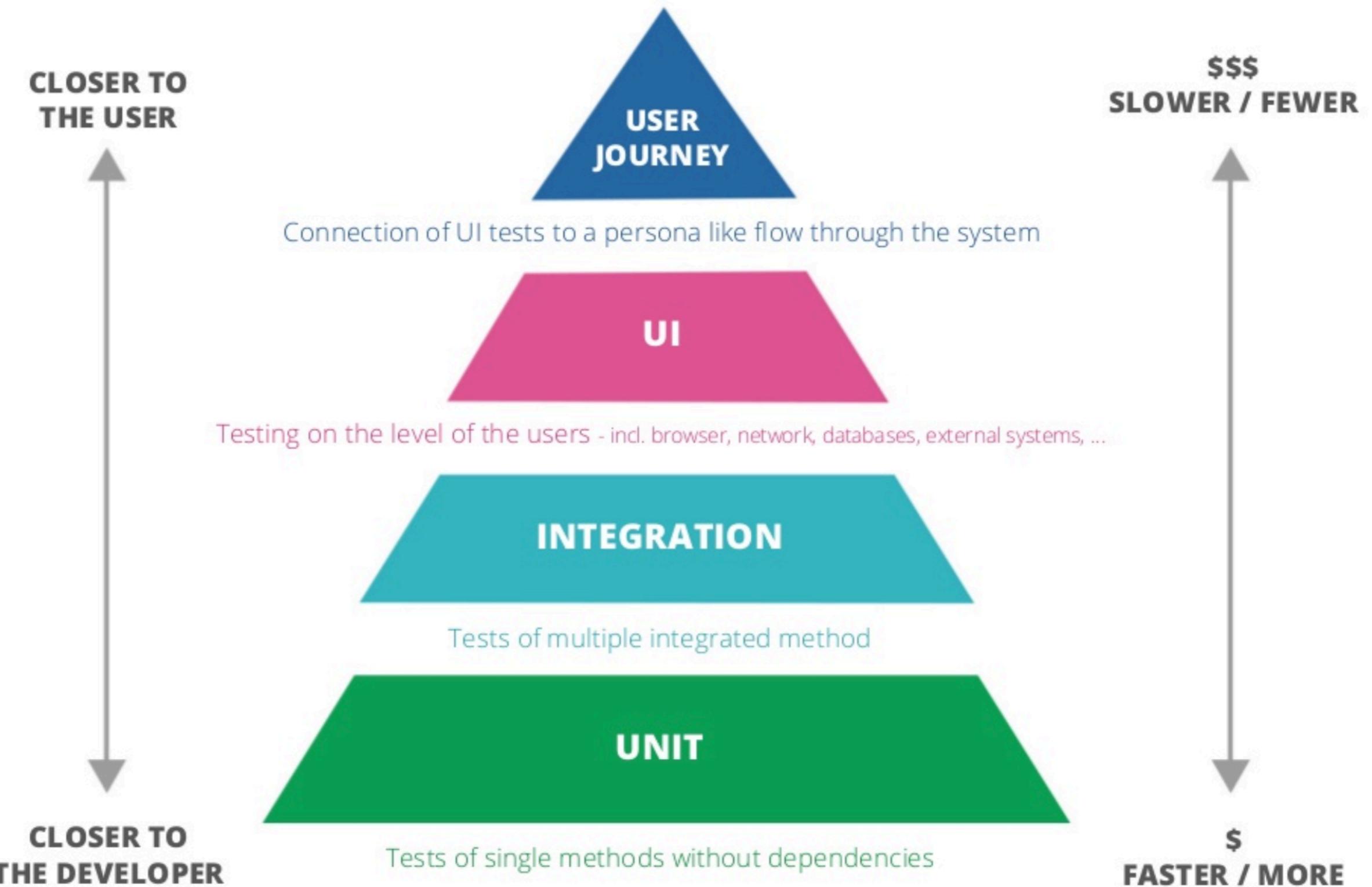


{ "message": "Hello somkiat" }



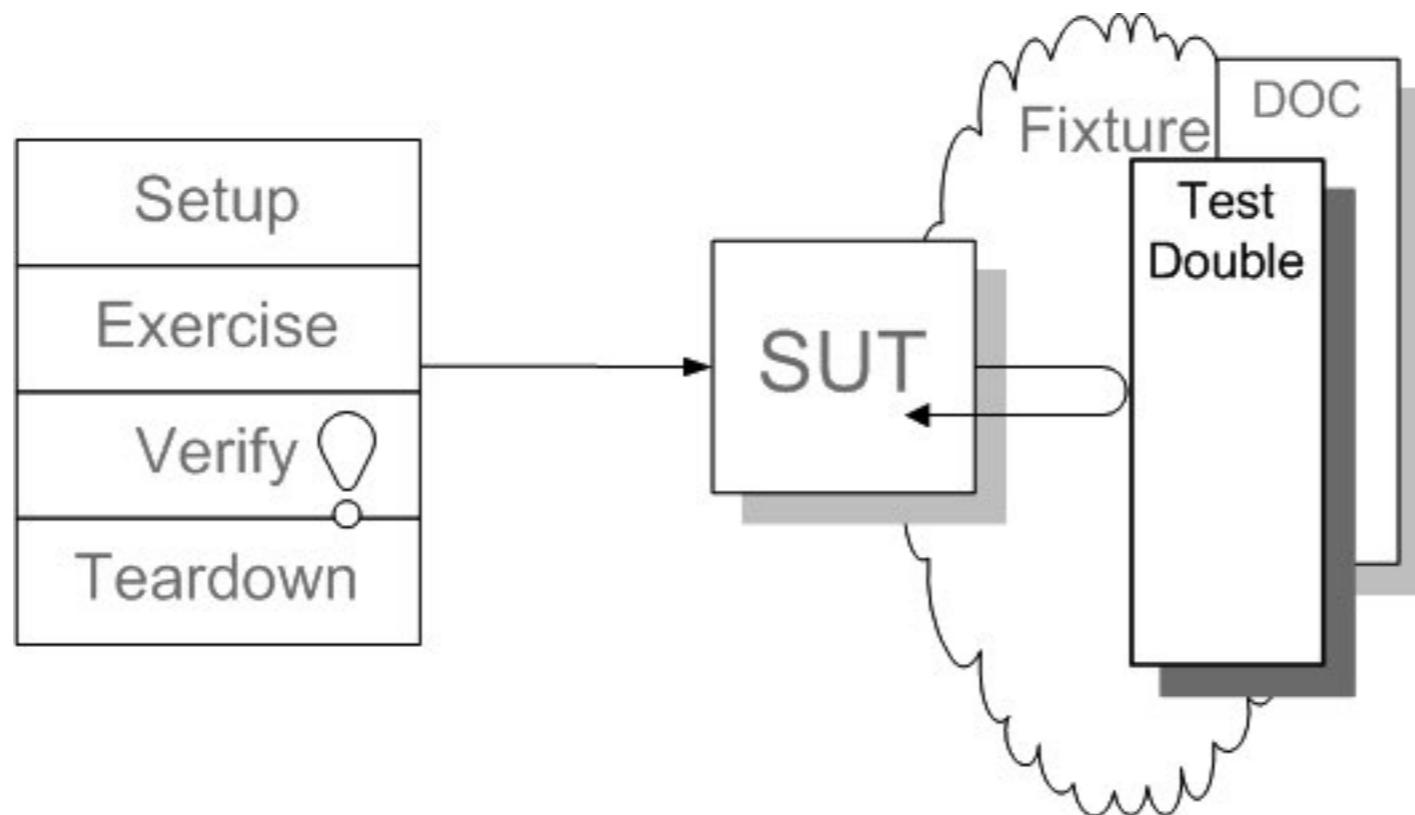
# How to test the Hello controller ?





# Test Double

How can we verify logic independently ?  
How can we avoid Slow tests ?



<http://xunitpatterns.com/Test%20Double.html>



# Types of Test Double

Based on **how** and **why** we use it !!

Dummy  
object

Test  
stub

Test  
spy

Mock  
object

Fake  
object



# Controller testing

## How to testing with Spring Boot ?



# Testing in Spring Boot

**@SpringBootTest**  
**@WebMVCTest**  
**@JsonTest**  
**@DataJpaTest**  
**@RestClientTest**



# Testing in Spring Boot

@SpringBootTest

@WebMVC Test

@JsonTest

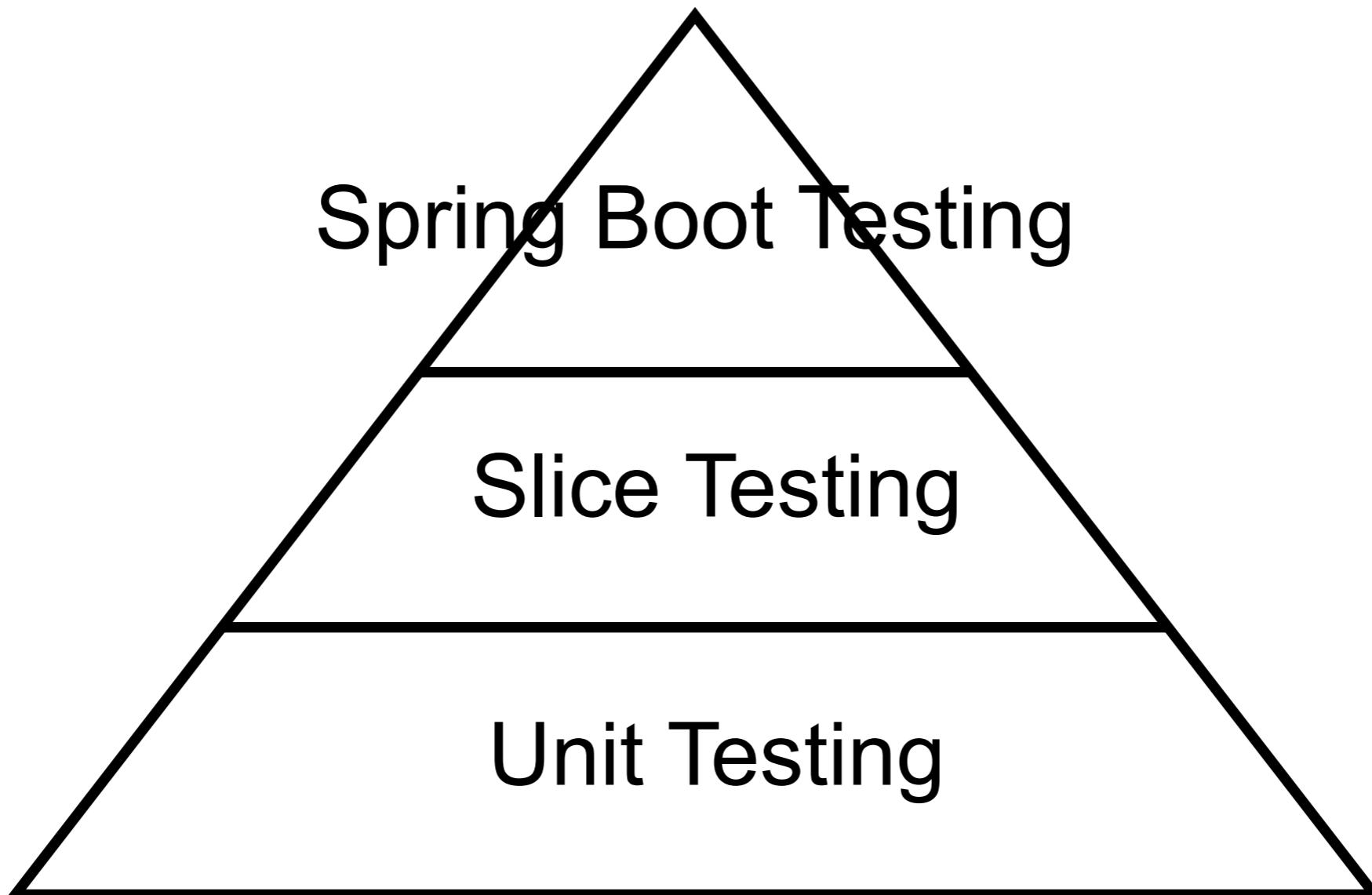
@DataJpaTest

@RestClientTest

**Slice testing**



# Testing in Spring Boot



# Controller testing

1. Spring Boot Testing
2. Slice Testing with MockMvc
3. Unit Testing



# 1. SpringBootTest

## Application context

Controller Advice

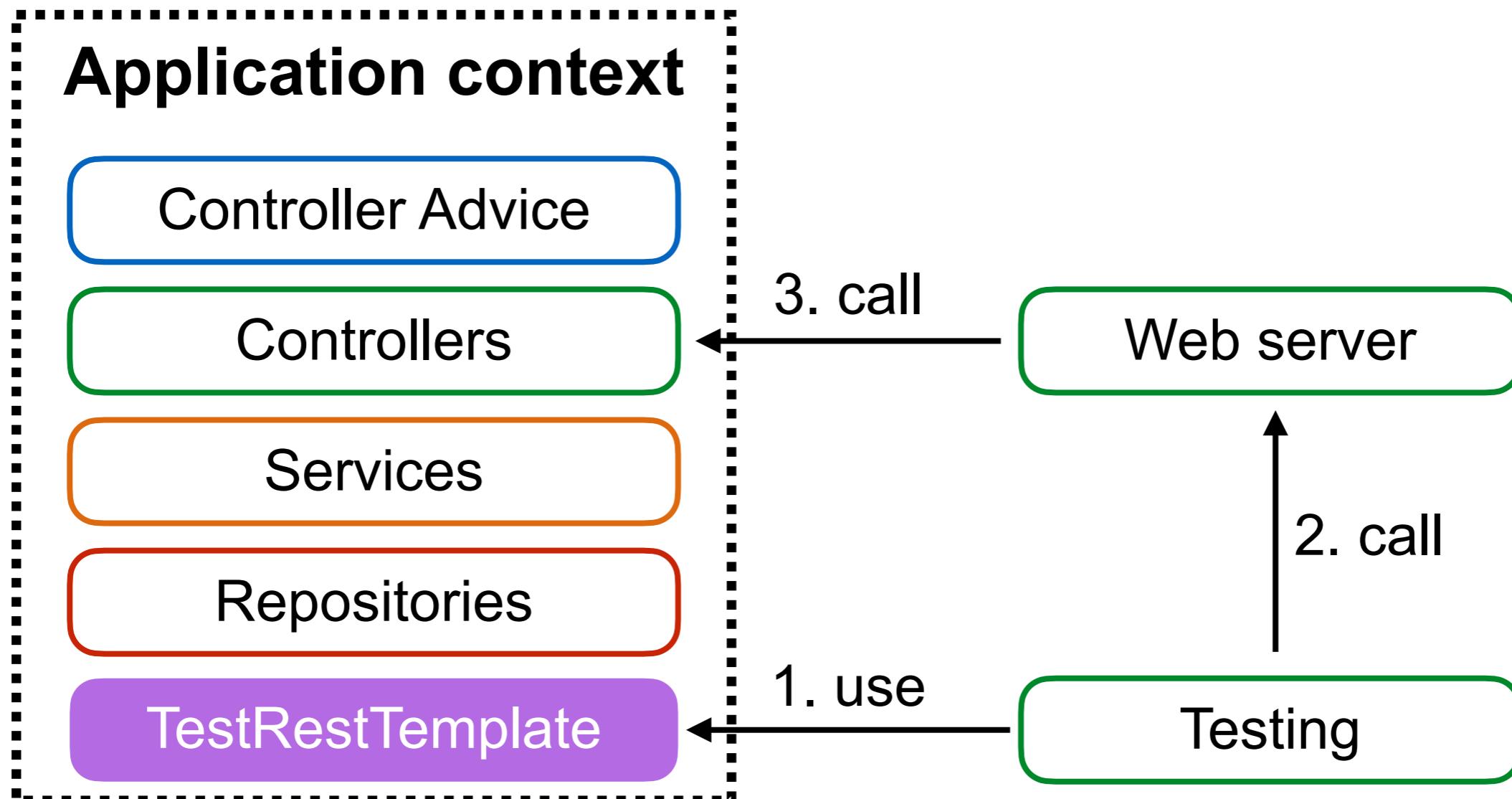
Controllers

Services

Repositories



# 1. SpringBootTest



# SpringBootTest #1

```
@RunWith(SpringRunner.class)
@SpringBootTest(webEnvironment
        = SpringBootTest.WebEnvironment.RANDOM_PORT)
public class HelloControllerTest {

    @Autowired
    private TestRestTemplate testRestTemplate;

    @Test
    public void sayHi() {
        // Action :: Call controller
        Hello actualResult
            = testRestTemplate.getForObject("/hello/somkiat",
                                            Hello.class);

        // Assertion :: Check result with expected result
        assertEquals("Hello, somkiat", actualResult.getMessage());
    }
}
```



# SpringBootTest #2

```
@RunWith(SpringRunner.class)
@SpringBootTest(webEnvironment
        = SpringBootTest.WebEnvironment.RANDOM_PORT)
public class HelloControllerTest {

    @Autowired
    private TestRestTemplate testRestTemplate;

    @Test
    public void sayHi() {
        // Action :: Call controller
        Hello actualResult
            = testRestTemplate.getForObject("/hello/somkiat",
                                            Hello.class);

        // Assertion :: Check result with expected result
        assertEquals("Hello, somkiat", actualResult.getMessage());
    }
}
```



# SpringBootTest #3

```
@RunWith(SpringRunner.class)
@SpringBootTest(webEnvironment
        = SpringBootTest.WebEnvironment.RANDOM_PORT)
public class HelloControllerTest {

    @Autowired
    private TestRestTemplate testRestTemplate;

    @Test
    public void sayHi() {
        // Action :: Call controller
        Hello actualResult
            = testRestTemplate.getForObject("/hello/somkiat",
                                            Hello.class);

        // Assertion :: Check result with expected result
        assertEquals("Hello, somkiat", actualResult.getMessage());
    }
}
```



# 2. Slice Testing with MockMVC

## Application context

Controller Advice

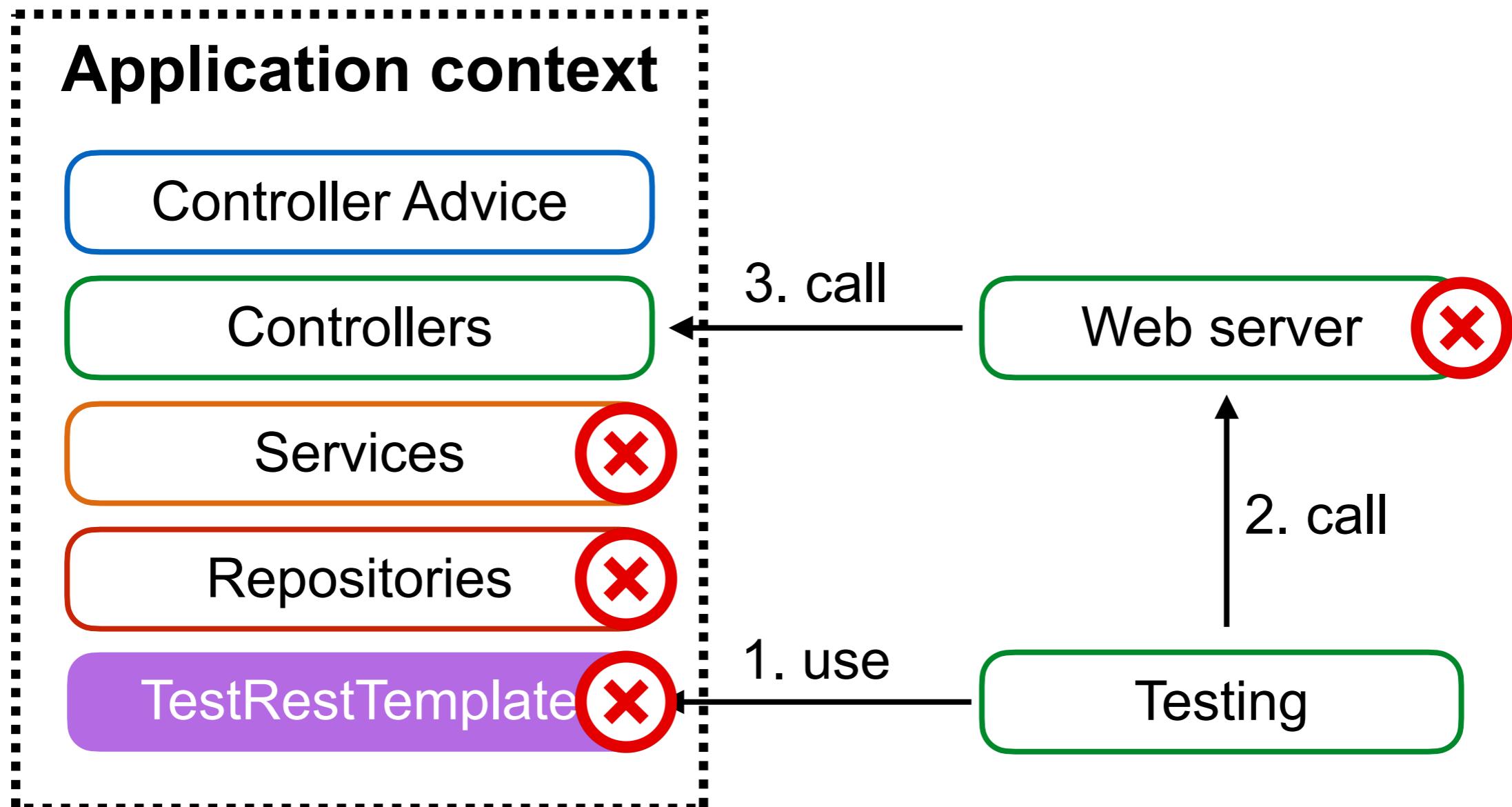
Controllers

Services

Repositories



# 2. Slice Testing with MockMVC



# MockMvcTest #1

```
@RunWith(SpringRunner.class)
@WebMvcTest(NumberController.class)
public class NumberControllerMockMvcTest {

    @MockBean
    private MyRandom stubRandom;

    @Autowired
    private MockMvc mvc;

    @Test
    public void success() throws Exception {
        NumberControllerResponse expected
            = new NumberControllerResponse("5555");

        // Stub
        given(stubRandom.nextInt(10)).willReturn(5555);
    }
}
```



# MockMvcTest #2

```
@RunWith(SpringRunner.class)
@WebMvcTest(NumberController.class)
public class NumberControllerMockMvcTest {

    @MockBean
    private MyRandom stubRandom;

    @Autowired
    private MockMvc mvc;

    @Test
    public void success() throws Exception {
        NumberControllerResponse expected
            = new NumberControllerResponse("5555");

        // Stub
        given(stubRandom.nextInt(10)).willReturn(5555);
    }
}
```



# MockMvcTest #3

## Use ObjectMapper to convert JSON to object

```
// Call API HTTP response code = 200
String response =
    this.mvc.perform(get("/number"))
    .andExpect(status().isOk())
    .andReturn()
    .getResponse().getContentAsString();

// Convert JSON message to Object
ObjectMapper mapper = new ObjectMapper();
NumberControllerResponse actual =
    mapper.readValue(response,
        NumberControllerResponse.class);
```



# 3. Unit testing with Controller



# Unit test

Use Test Double

In java, use Mockito library



<http://site.mockito.org/>



# Unit testing with Mockito #1

```
@RunWith(MockitoJUnitRunner.class)
public class NumberControllerUnitTest {

    @Mock
    private MyRandom stubRandom;

    @Test
    public void success() throws Exception {
        NumberControllerResponse expected
            = new NumberControllerResponse("5555");

        // Stub
        given(stubRandom.nextInt(10)).willReturn(5555);
    }
}
```



# Unit testing with Mockito #2

```
@RunWith(MockitoJUnitRunner.class)
public class NumberControllerUnitTest {

    @Mock
    private MyRandom stubRandom;

    @Test
    public void success() throws Exception {
        NumberControllerResponse expected
            = new NumberControllerResponse("5555");

        // Stub
        given(stubRandom.nextInt(10)).willReturn(5555);
    }
}
```



# Unit testing with Mockito #3

```
@Test
public void success() throws Exception {
    NumberControllerResponse expected
        = new NumberControllerResponse("5555");

    // Stub
    given(stubRandom.nextInt(10)).willReturn(5555);

    // Call
    NumberController controller = new NumberController(stubRandom);
    NumberControllerResponse actual = controller.randomNumber();

    // Assert
    assertEquals("5555", actual.getValue());
    assertEquals(expected, actual);
}
```



# Error handling



# Error handling

```
@Service
public class UserService {

    private AccountRepository accountRepository;

    @Autowired
    public UserService(AccountRepository accountRepository) {
        this.accountRepository = accountRepository;
    }

    public Account getAccount(int id) {
        Optional<Account> account = accountRepository.findById(id);
        if(account.isPresent()) {
            return account.get();
        }
        throw new MyAccountNotFoundException(
            String.format("Account id=[%d] not found", id));
    }
}
```



# MyAccountNotFoundException

```
public class MyAccountNotFoundException  
    extends RuntimeException {
```

```
    public MyAccountNotFoundException(String message) {  
        super(message);  
    }
```

```
}
```



# Response Status

404 = Not Found

Status	Description
400	Request body doesn't meet API spec
401	Authentication/Authorization fail
403	User can't perform the operation
404	Resource does not exist
405	Unsupported operation
500	Error on server



# Handling error in Spring Boot

```
@RestControllerAdvice  
public class AccountControllerHandler {  
  
    @ExceptionHandler(MyAccountNotFoundException.class)  
    public ResponseEntity<ExceptionResponse> accountNotFound(  
        MyAccountNotFoundException exception) {  
  
        ExceptionResponse response =  
            new ExceptionResponse(exception.getMessage(),  
                "More detail");  
  
        return new ResponseEntity<ExceptionResponse>(response,  
            HttpStatus.NOT_FOUND);  
    }  
}
```

1



# Handling error in Spring Boot

```
@RestControllerAdvice  
public class AccountControllerHandler {  
  
    @ExceptionHandler(MyAccountNotFoundException.class)  
    public ResponseEntity<ExceptionResponse> accountNotFound(  
        MyAccountNotFoundException exception) {  
  
        ExceptionResponse response =  
            new ExceptionResponse(exception.getMessage(),  
                "More detail");  
  
        return new ResponseEntity<ExceptionResponse>(response,  
            HttpStatus.NOT_FOUND);  
    }  
}
```

2



# ExceptionResponse

Response format of error

```
public class ExceptionResponse{  
  
    private Date timestamp = new Date();  
    private String message;  
    private String detail;  
  
    public ExceptionResponse(String message, String detail) {  
        this.message = message;  
        this.detail = detail;  
    }  
}
```



# Result of API

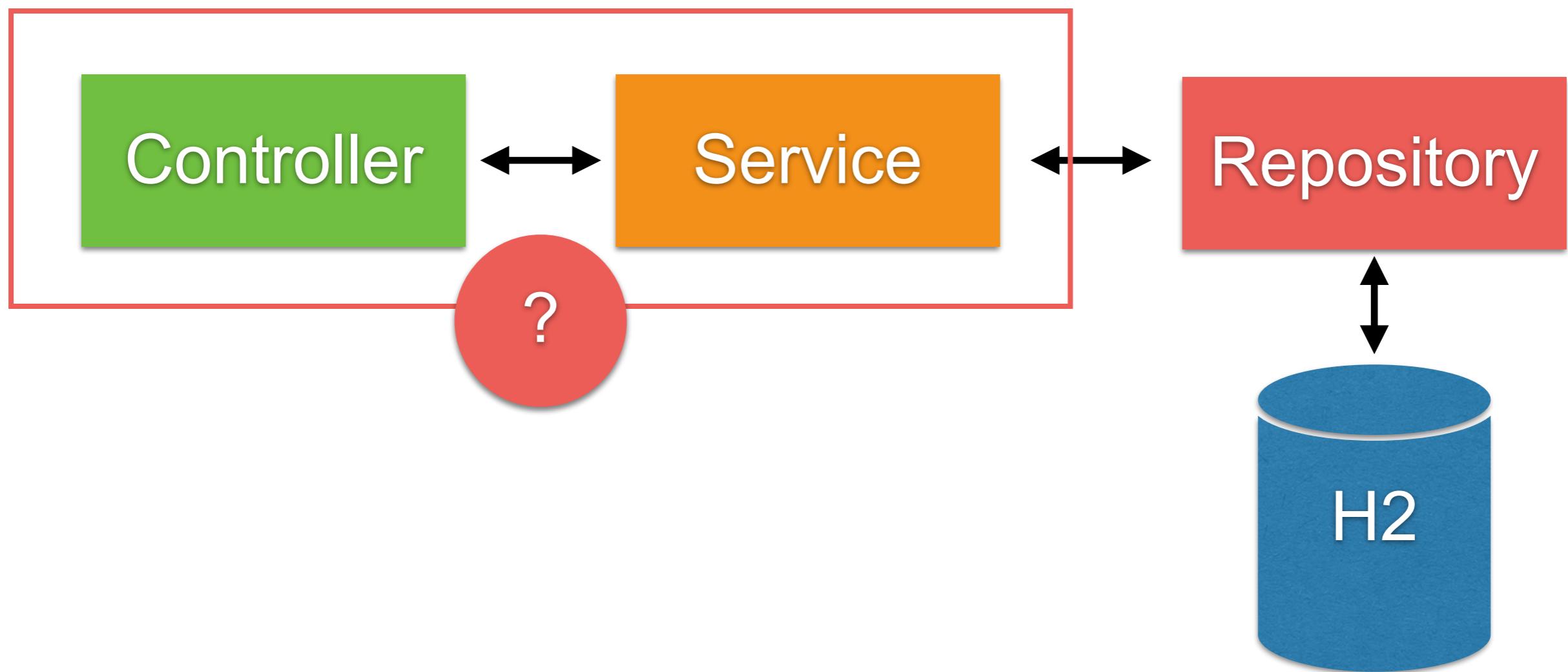
```
← → ⌂ ⓘ localhost:8888/account/2 🔍 ☆
{
  timestamp: "2018-09-15T15:25:44.776+0000",
  message: "Account id=[ 2 ] not found",
  detail: "More detail"
}
```



# How to test ?



# How to test with Error/Exception ?



# Testing with WebMvcTest and MockMvc

Try to check data in response

```
@Test  
public void getByIdWithNotFoundAccount() throws Exception {  
    // Stub  
    given(userService.getAccount(2))  
        .willThrow(new MyAccountNotFoundException("Not found"));  
  
    mockMvc.perform(  
        get("/account/2")  
            .accept(MediaType.APPLICATION_JSON))  
        .andExpect(status().isNotFound())  
        .andExpect(content().contentType(MediaType.APPLICATION_JSON_UTF8))  
        .andExpect(jsonPath("$.message", is("Not found")));  
}
```

1



# Testing with WebMvcTest and MockMvc

Try to check data in response

```
@Test  
public void getByIdWithNotFoundAccount() throws Exception {  
    // Stub  
    given(userService.getAccount(2))  
        .willThrow(new MyAccountNotFoundException("Not found"));  
  
    mockMvc.perform(  
        get("/account/2")  
            .accept(MediaType.APPLICATION_JSON))  
        .andExpect(status().isNotFound())  
        .andExpect(content().contentType(MediaType.APPLICATION_JSON_UTF8))  
        .andExpect(jsonPath("$.message", is("Not found")));  
}
```

2



# Testing with Service

Try to check exception

```
@ExtendWith(MockitoExtension.class)
public class UserServiceTest {

    @Mock
    private UserRepository userRepository;

    @Test
    public void user_not_found_with_exception() {
        given(userRepository.findById(1))
            .willReturn(Optional.empty());
        UserService userService = new UserService();
        userService.setRepository(userRepository);

        Assertions.assertThrows(RuntimeException.class, () -> {
            userService.getData(1);
        });
    }
}
```



# Compile with testing

```
$mvnw clean test
```

```
[INFO]  
[INFO] Results:  
[INFO]  
[INFO] Tests run: 2, Failures: 0, Errors: 0, Skipped: 0  
[INFO]  
[INFO]
```



# Code coverage



**"Code coverage can show the high risk areas in a program, but never the risk-free."**

Paul Reilly, 2018, Kotlin TDD with Code Coverage



# Code coverage

A tool to measure how much of your code is covered by tests that break down into classes, methods and lines.



# Code coverage

But 100% of code coverage **does not mean** that your code is 100% correct



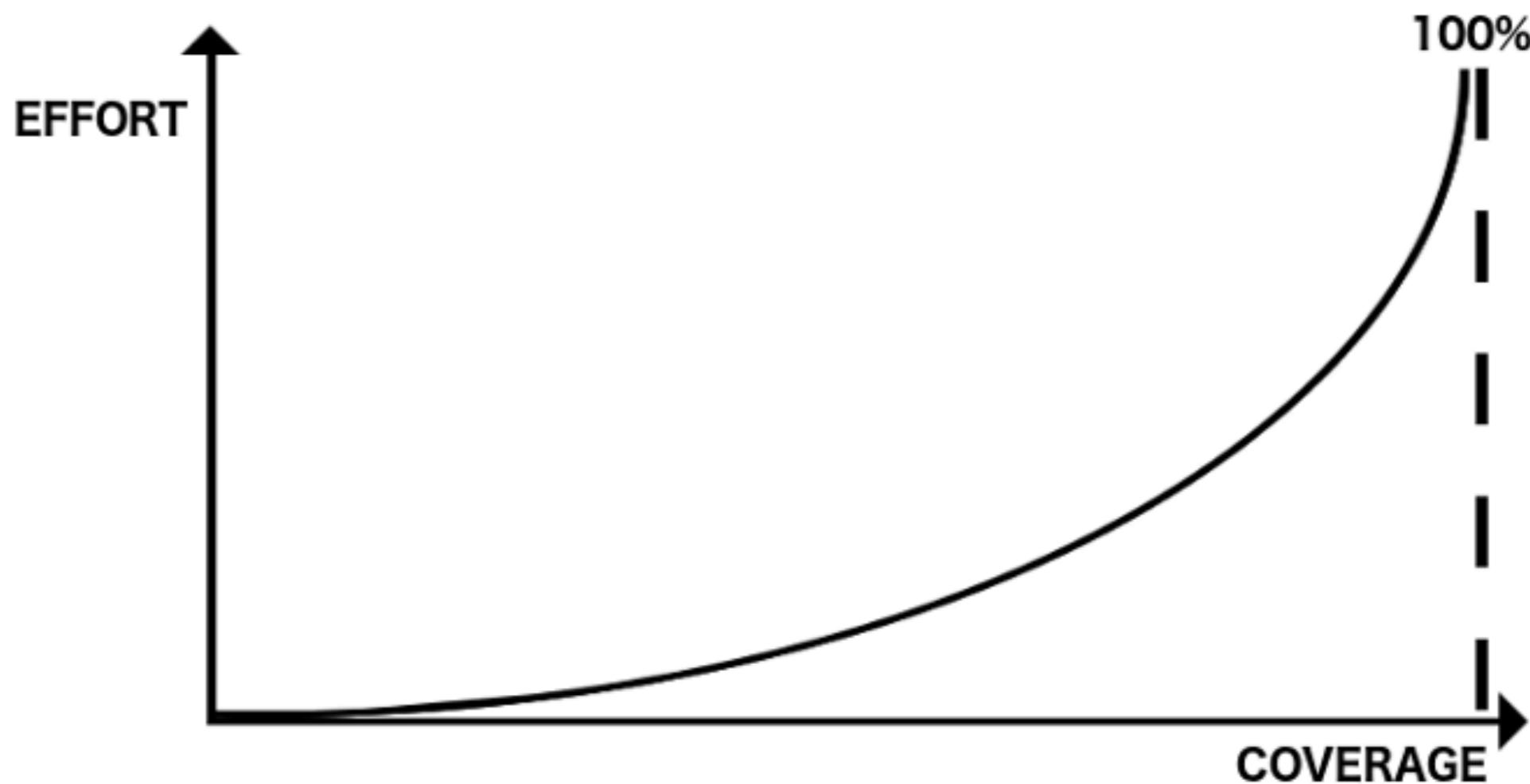
# Code coverage

Powerful tool to improve the quality of your code

**Code coverage != quality of tests**



# Code coverage 100% ?



# % of Code/Test coverage



# Code coverage with Java

Cobertura  
Jacoco

<http://bit.ly/2DIlsDeX>



# Run test again

\$mvnw clean package

Cobertura Report generation was successful.

Cobertura 2.1.1 - GNU GPL License (NO WARRANTY) - See COPYRIGHT file

Cobertura: Loaded information on 3 classes.

time: 125ms

Cobertura Report generation was successful.

---

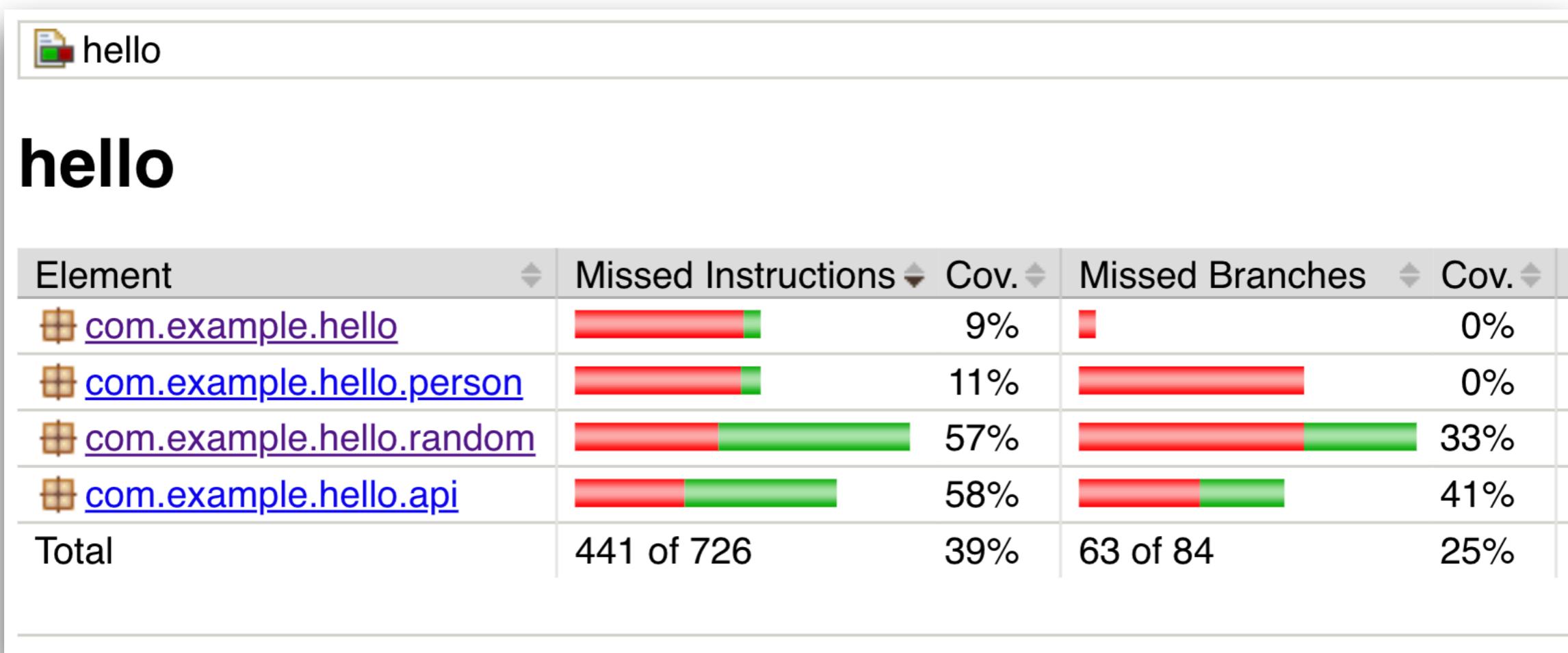
BUILD SUCCESS

---



# Coverage report

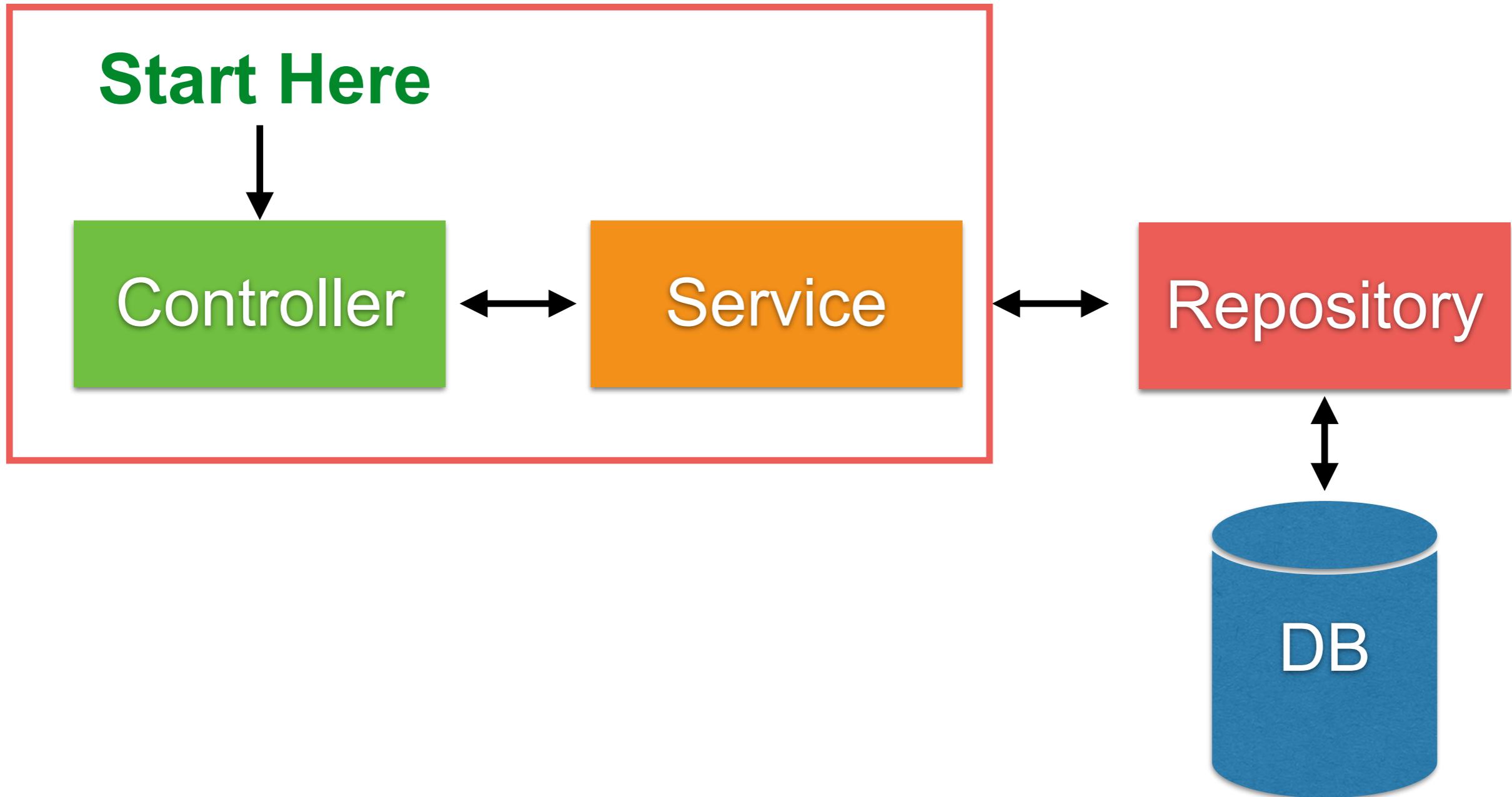
open target/site/jacoco/index.html



# Move business logic to service

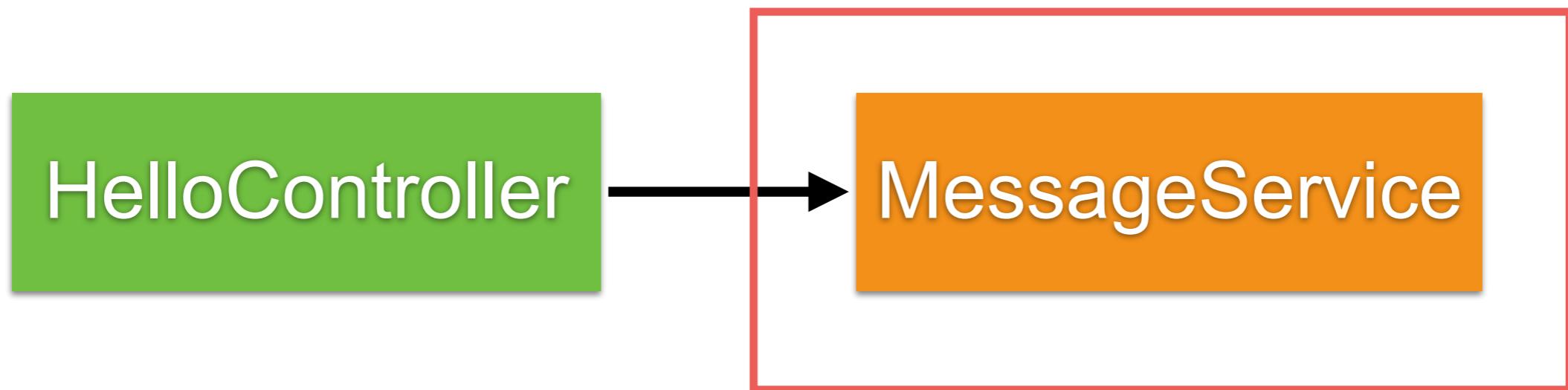


# Working with service



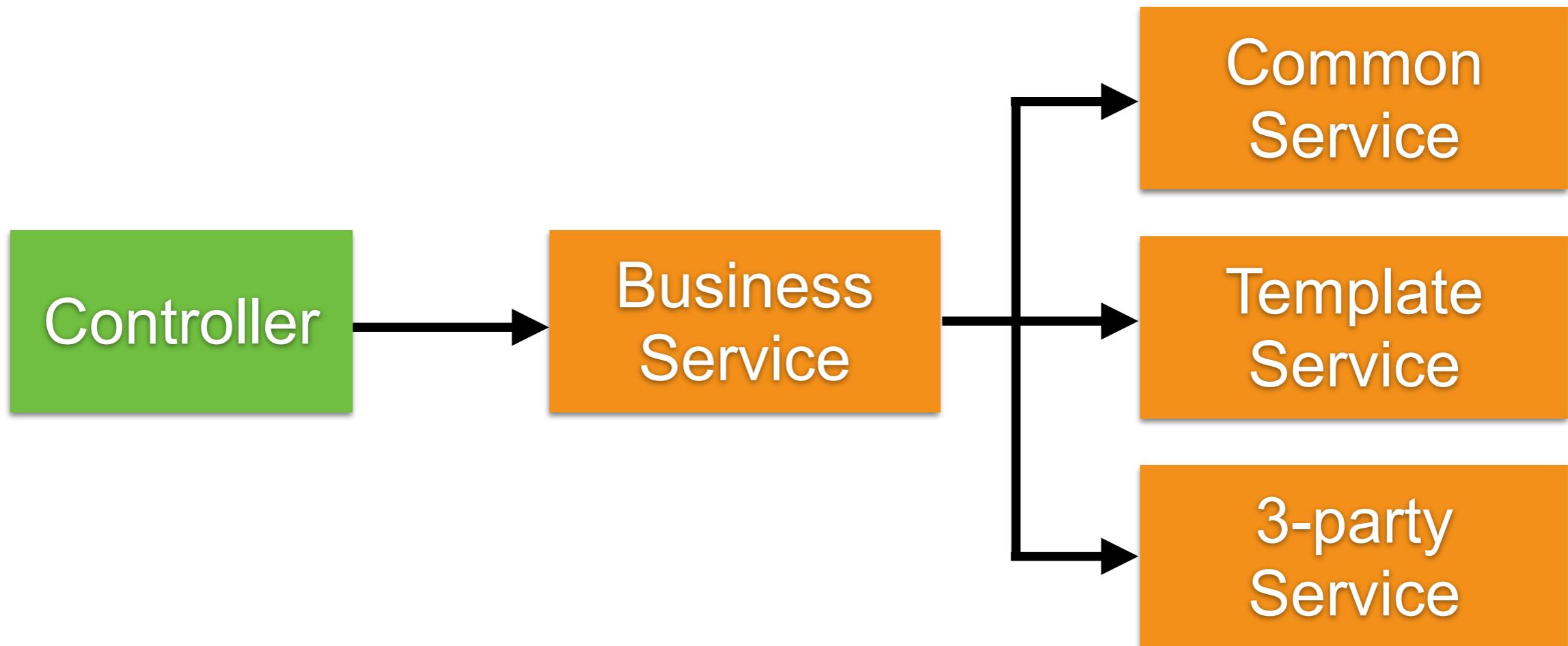
# Move business logic to service

Service class or interface ?

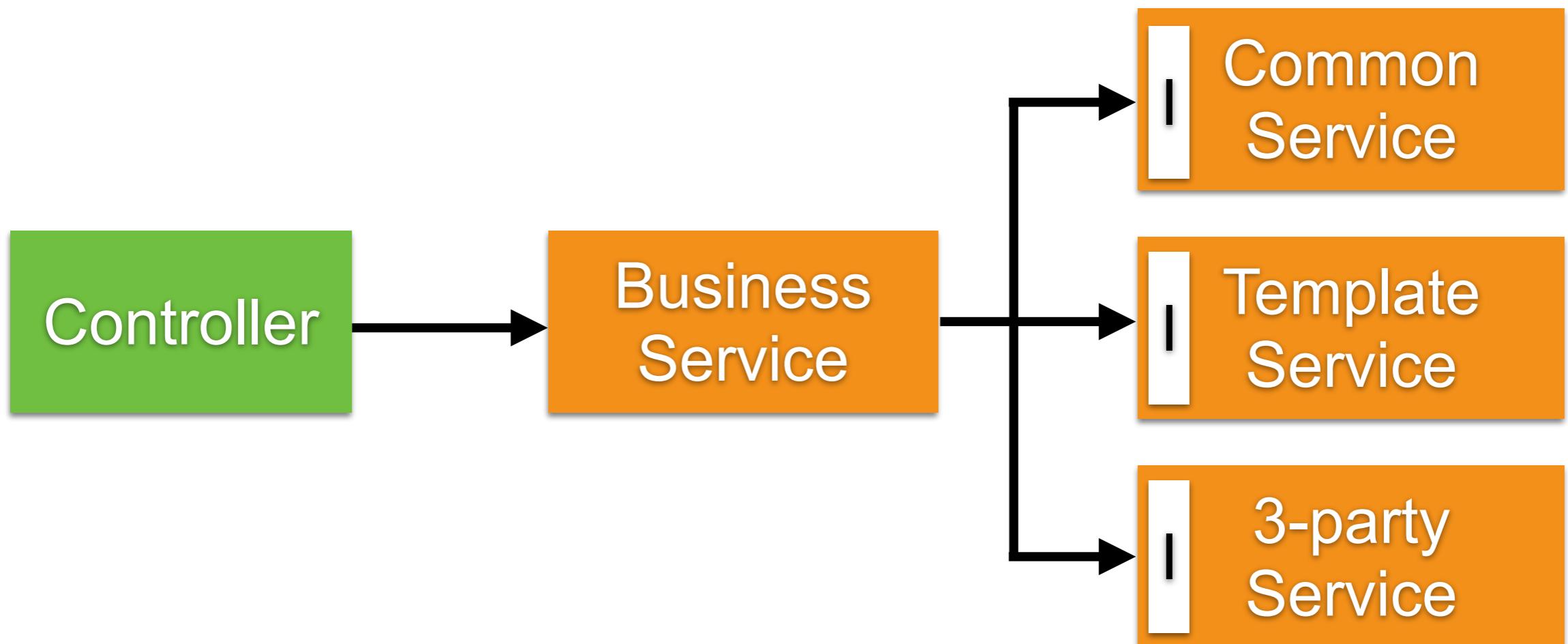


# Types of service

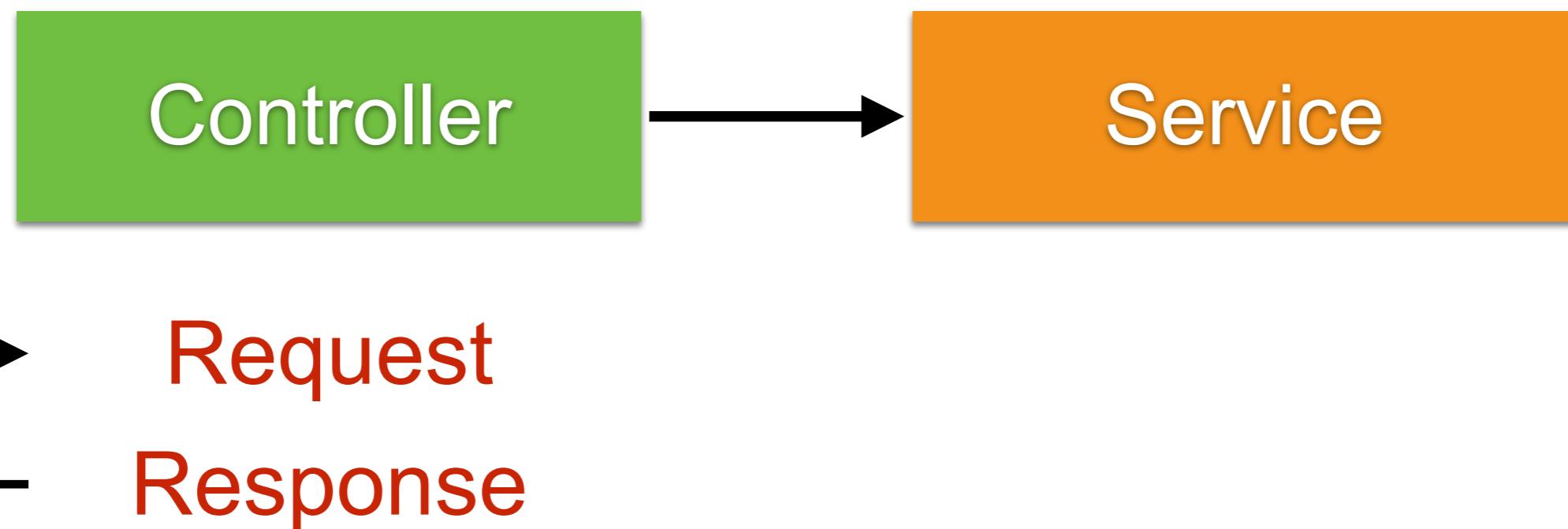
Business services (not reuse)  
Common/Template/3-party services



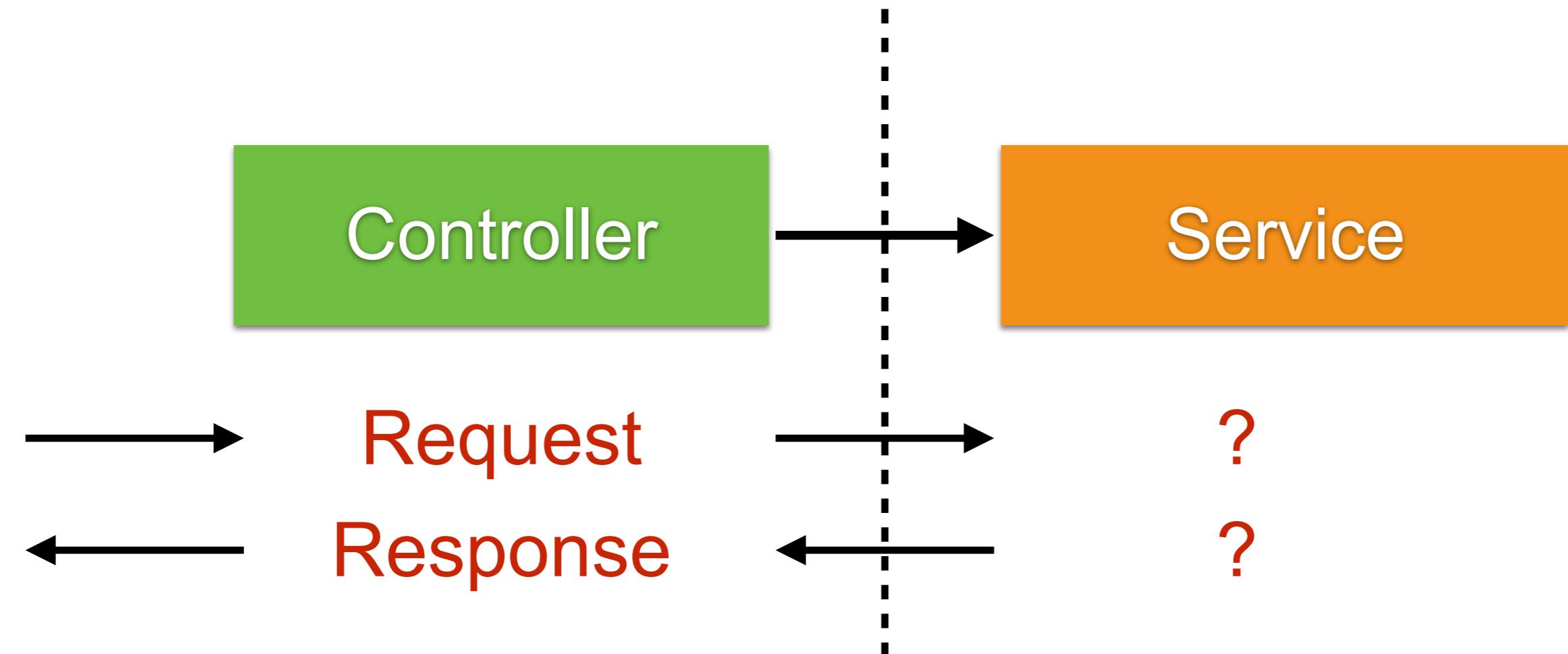
# Interface for common service



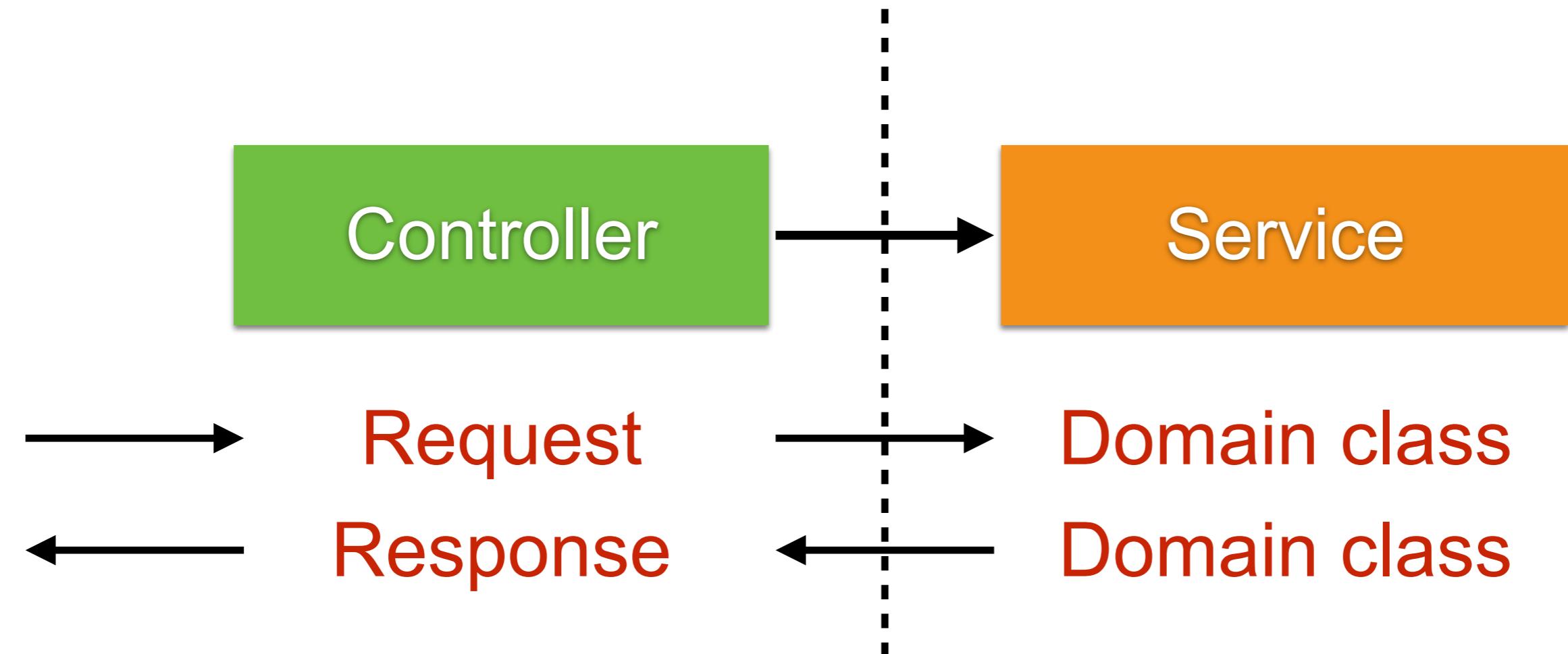
# Data Model for service ?



# Data Model ?

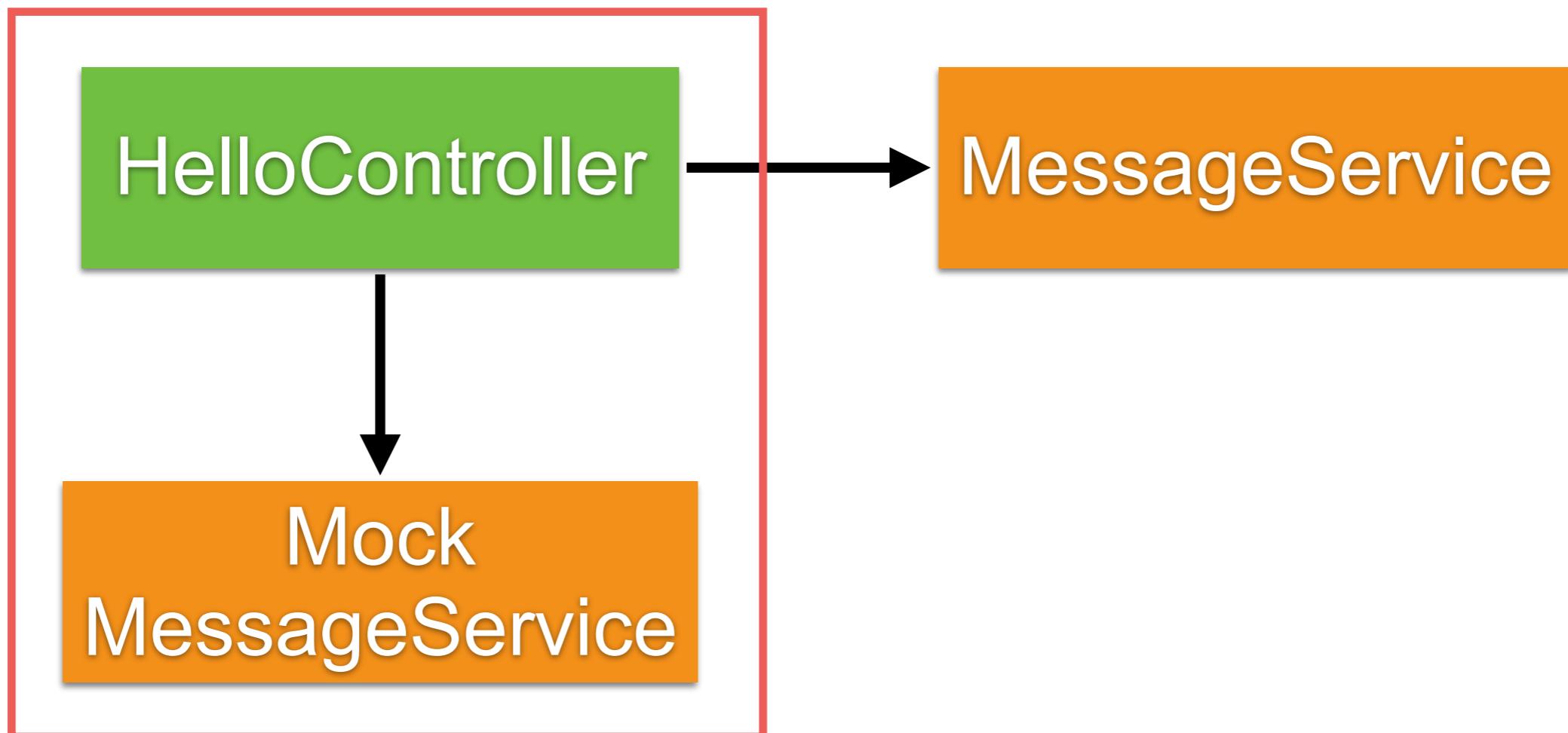


# Data Model ?



# Testing controller with service

Try to mocking service with Mockito



# Run all tests !!

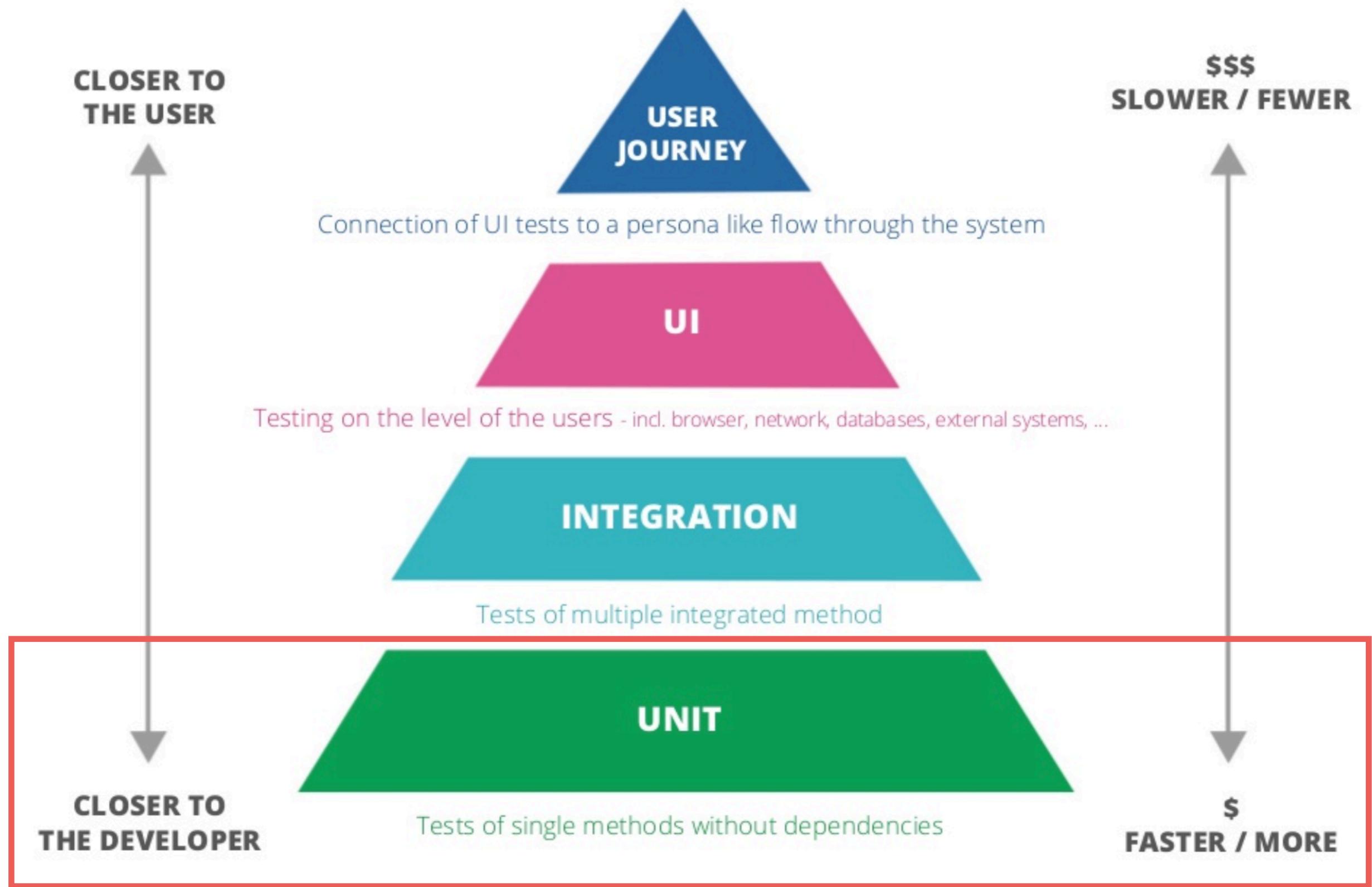
\$mvnw clean test

```
[INFO]
[INFO] Results:
[INFO]
[WARNING] Tests run: 10, Failures: 0, Errors: 0,
[INFO]
[INFO] -----
[INFO] BUILD SUCCESS
[INFO] -----
[INFO] Total time: 18.299 s
[INFO] Finished at: 2018-08-20T23:36:31+07:00
[INFO] -----
```

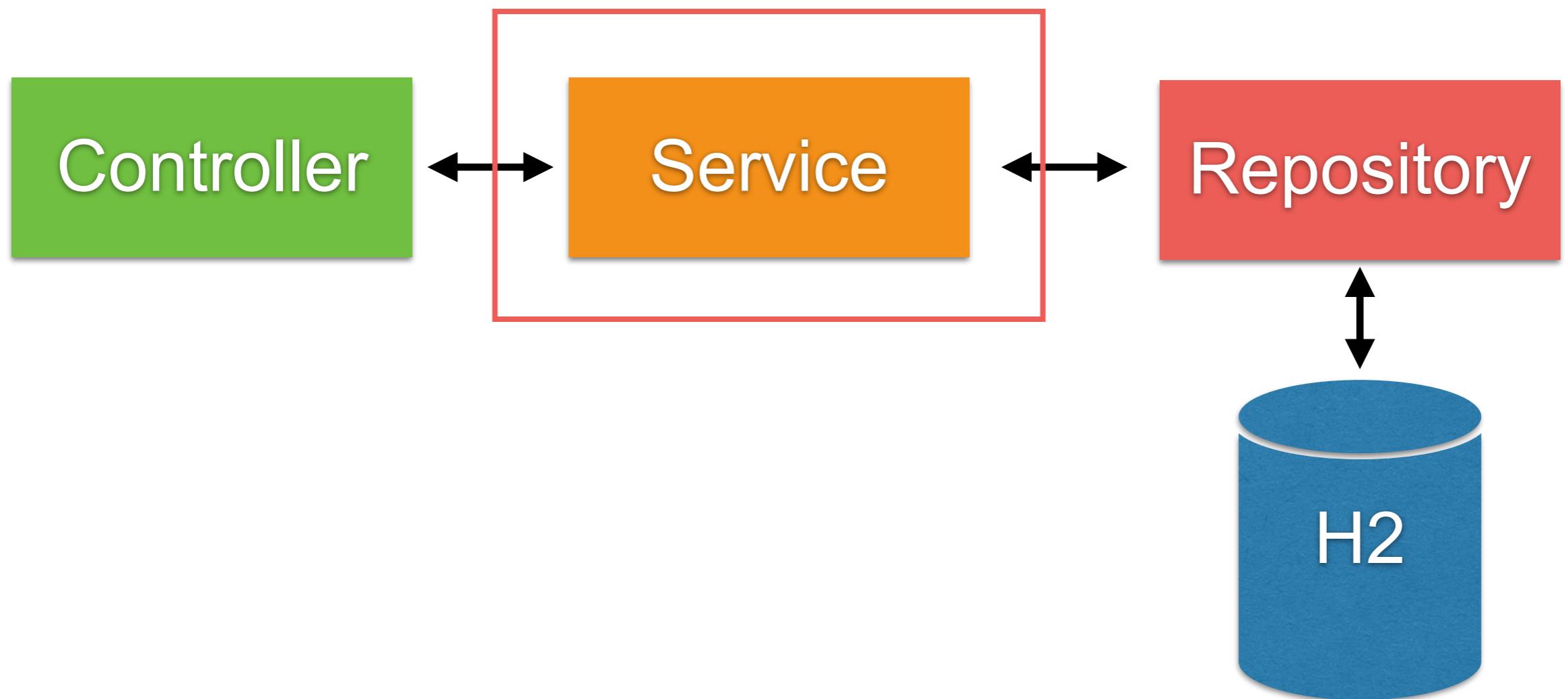


# **How to improve the speed of testing ?**





# Service Testing ?



# Service Testing

```
@ExtendWith(MockitoExtension.class)
public class UserServiceTest {

    @Mock
    private AccountRepository accountRepository;

    @Test
    public void getAccount() {
        // Stub
        Account account = new Account();
        account.setUserName("user");
        account.setPassword("pass");
        account.setSalary(1000);
        given(accountRepository.findById(1))
            .willReturn(Optional.of(account));

        UserService userService = new UserService(accountRepository);
        Account actualAccount = userService.getAccount(1);
        assertNotNull(actualAccount);
    }
}
```

1



# Service Testing

```
@ExtendWith(MockitoExtension.class)
```

```
public class UserServiceTest {
```

```
    @Mock
```

```
    private AccountRepository accountRepository;
```

```
    @Test
```

```
    public void getAccount() {
```

```
        // Stub
```

```
        Account account = new Account();
```

```
        account.setUserName("user");
```

```
        account.setPassword("pass");
```

```
        account.setSalary(1000);
```

```
        given(accountRepository.findById(1))
```

```
            .willReturn(Optional.of(account));
```



2

```
        UserService userService = new UserService(accountRepository);
```

```
        Account actualAccount = userService.getAccount(1);
```

```
        assertNotNull(actualAccount);
```

```
}
```

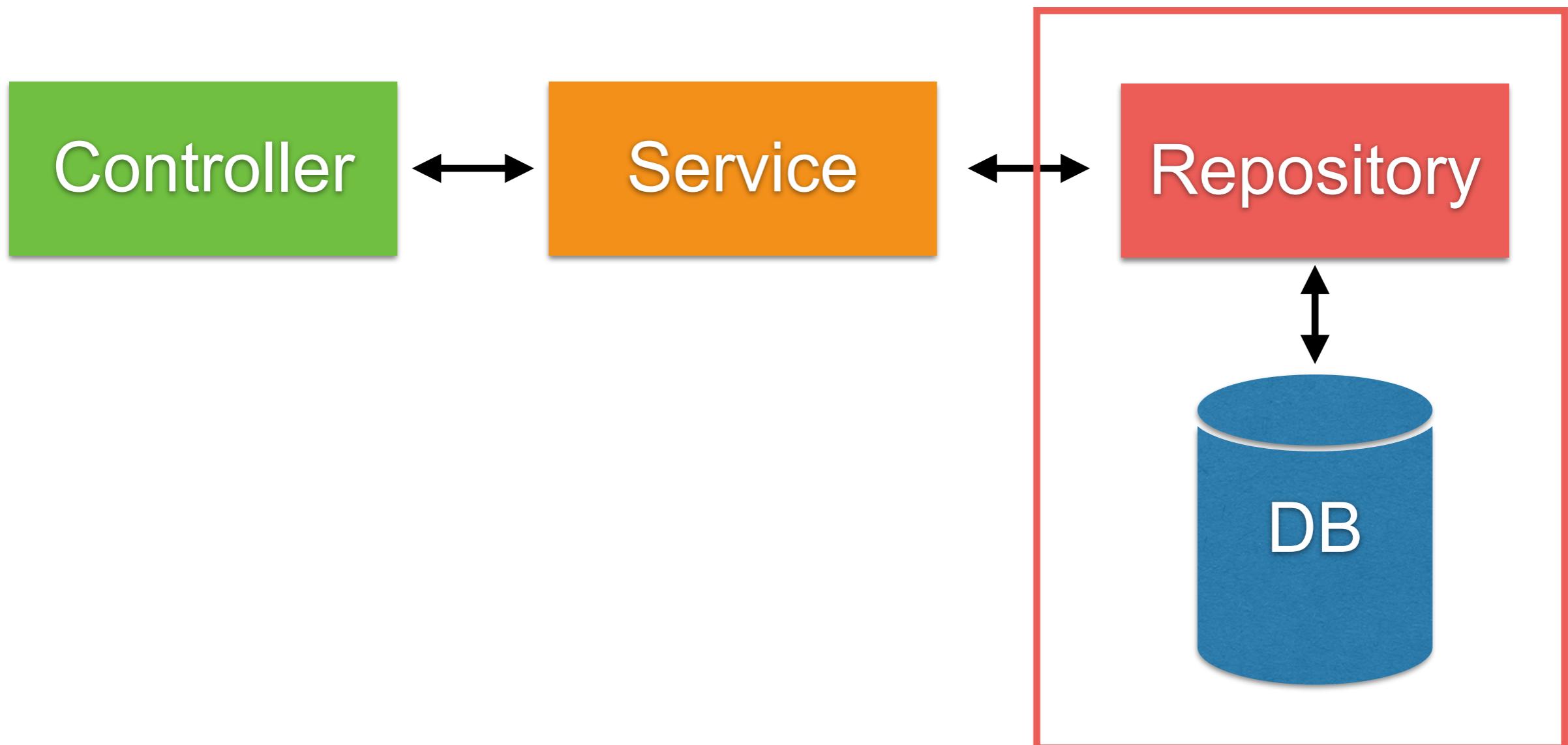
```
}
```



# Working with Repository



# Working with repository



# Basic of JDBC

```
// 1. Load jdbc driver
Class.forName("postgresql");

// 2. Create connection
Connection connection = DriverManager.getConnection("", "", "");

// 3. Prepared Statement
String sql = "SELECT * FROM TABLE WHERE name=?";
PreparedStatement pStmt = connection.prepareStatement(sql);

// 4. Query
ResultSet resultSet = pStmt.executeQuery();
while(resultSet.next()) {

}

// 5. Release resource
if(resultSet != null) {
    resultSet.close();
    resultSet = null;
}
```



# Framework !!

```
// 1. Load jdbc driver  
Class.forName("postgresql");  
// 2. Create connection  
Connection connection = DriverManager.getConnection("", "", "");  
  
Manage by Framework
```

```
// 3. Prepared Statement  
String sql = "SELECT * FROM TABLE WHERE name=?";  
PreparedStatement pStmt = connection.prepareStatement(sql);
```

```
// 4. Query  
ResultSet resultSet = pStmt.executeQuery();  
while(resultSet.next()) {  
}
```

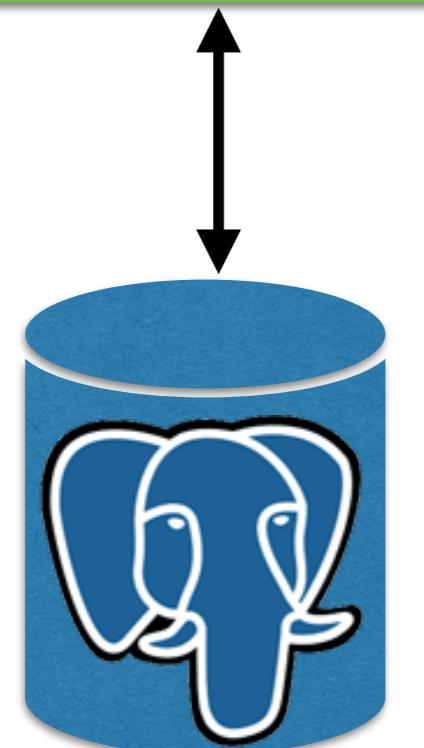
```
// 5. Release resource  
if(resultSet != null) {  
    resultSet.close();  
    resultSet = null;  
}
```

Manage by Framework



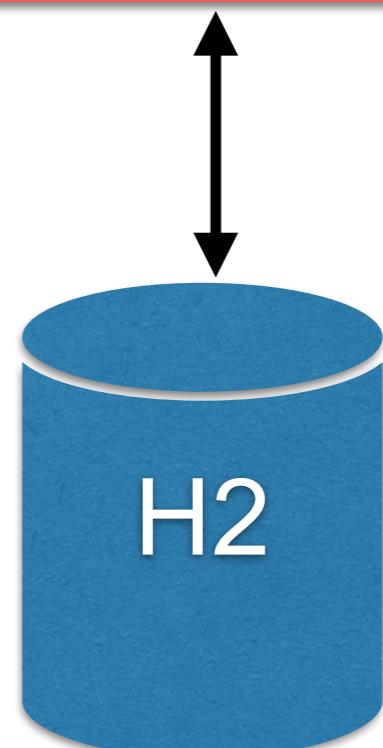
# Working with Database ?

Production



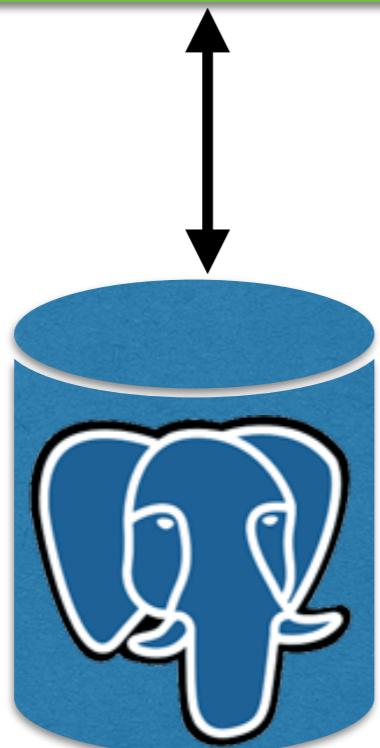
PostgreSQL

Testing



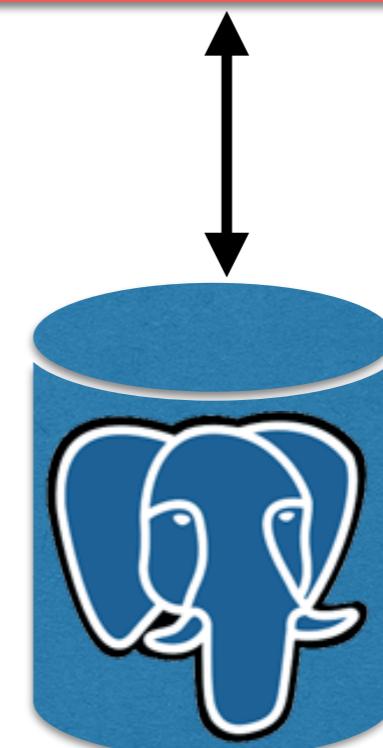
# Working with Database ?

Production



PostgreSQL

Testing

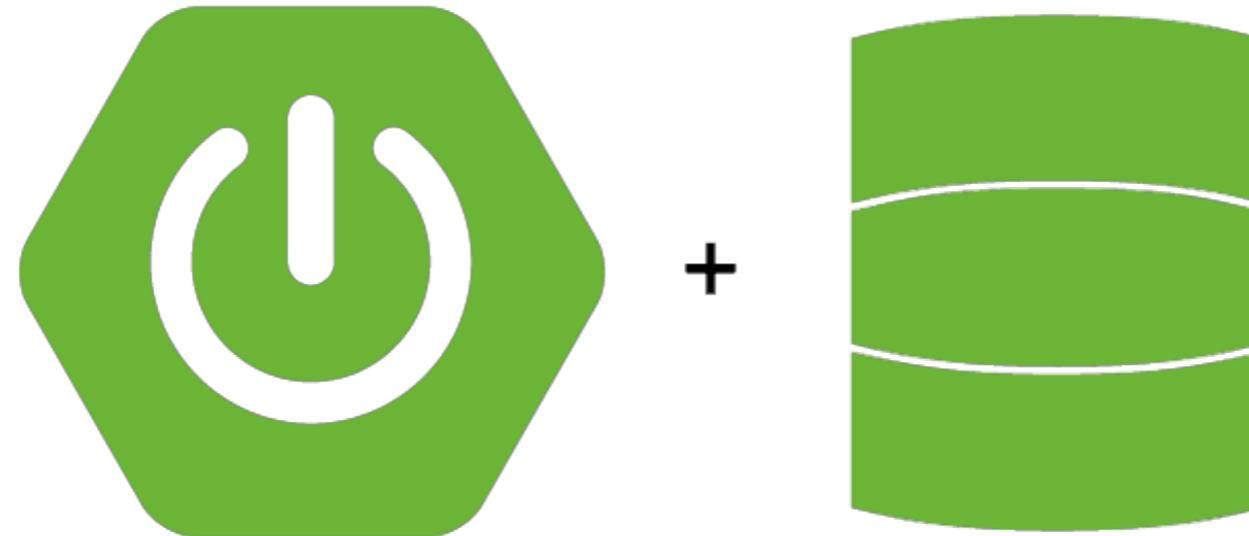


PostgreSQL



# Working with repository

We're using Spring Data



<https://spring.io/projects/spring-data>



# Spring Data

JDBC

JPA

MongoDB

Redis

more ...

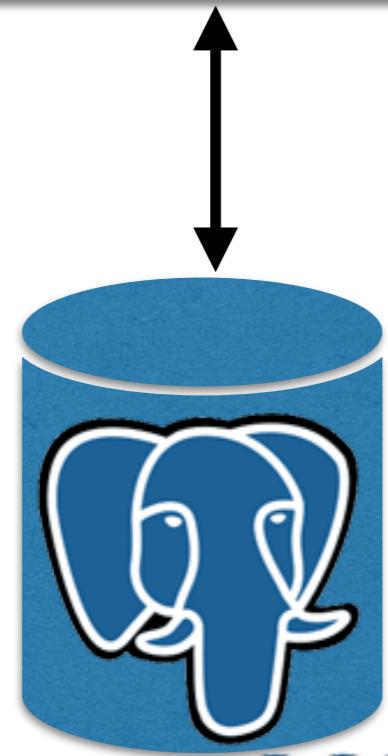


# Working with Spring Data JPA



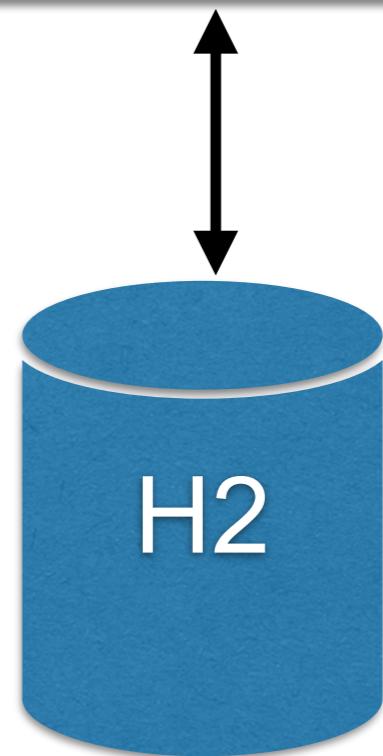
# Working with Database

Production



PostgreSQL

Testing



# Modify pom.xml

Add library of Spring Data JPA, PostgreSQL, H2

The screenshot shows a web-based interface for selecting dependencies. On the left, a sidebar labeled "Dependencies" contains a search bar with placeholder text "Search dependencies to add" and a list of suggestions: "Web, Security, JPA, Actuator, Devtools...". To the right, a main area titled "Dependencies selected" lists three chosen dependencies in boxes:

- JPA [SQL]**: Persist data in SQL stores with Java Persistence API using Spring Data and Hibernate.
- PostgreSQL [SQL]**: PostgreSQL JDBC driver.
- H2 [SQL]**: H2 database (with embedded support).

<https://start.spring.io/>



# Modify pom.xml

## H2 for testing

```
<dependency>
    <groupId>org.springframework.boot</groupId>
    <artifactId>spring-boot-starter-data-jpa</artifactId>
</dependency>
```

```
<dependency>
    <groupId>com.h2database</groupId>
    <artifactId>h2</artifactId>
    <scope>test</scope>
</dependency>
```

```
<dependency>
    <groupId>org.postgresql</groupId>
    <artifactId>postgresql</artifactId>
    <scope>runtime</scope>
</dependency>
```



# Modify pom.xml

## PostgreSQL for production

```
<dependency>
    <groupId>org.springframework.boot</groupId>
    <artifactId>spring-boot-starter-data-jpa</artifactId>
</dependency>

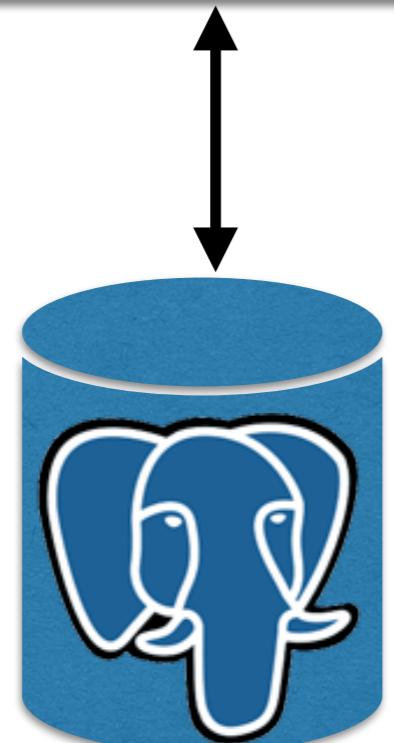
<dependency>
    <groupId>com.h2database</groupId>
    <artifactId>h2</artifactId>
    <scope>test</scope>
</dependency>

<dependency>
    <groupId>org.postgresql</groupId>
    <artifactId>postgresql</artifactId>
    <scope>runtime</scope>
</dependency>
```



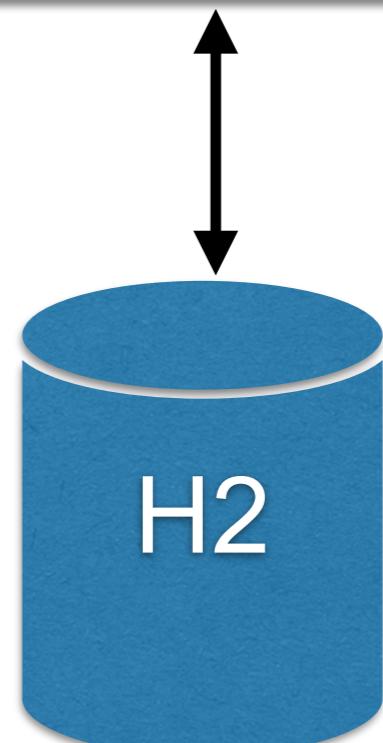
# Start in testing scope

Production

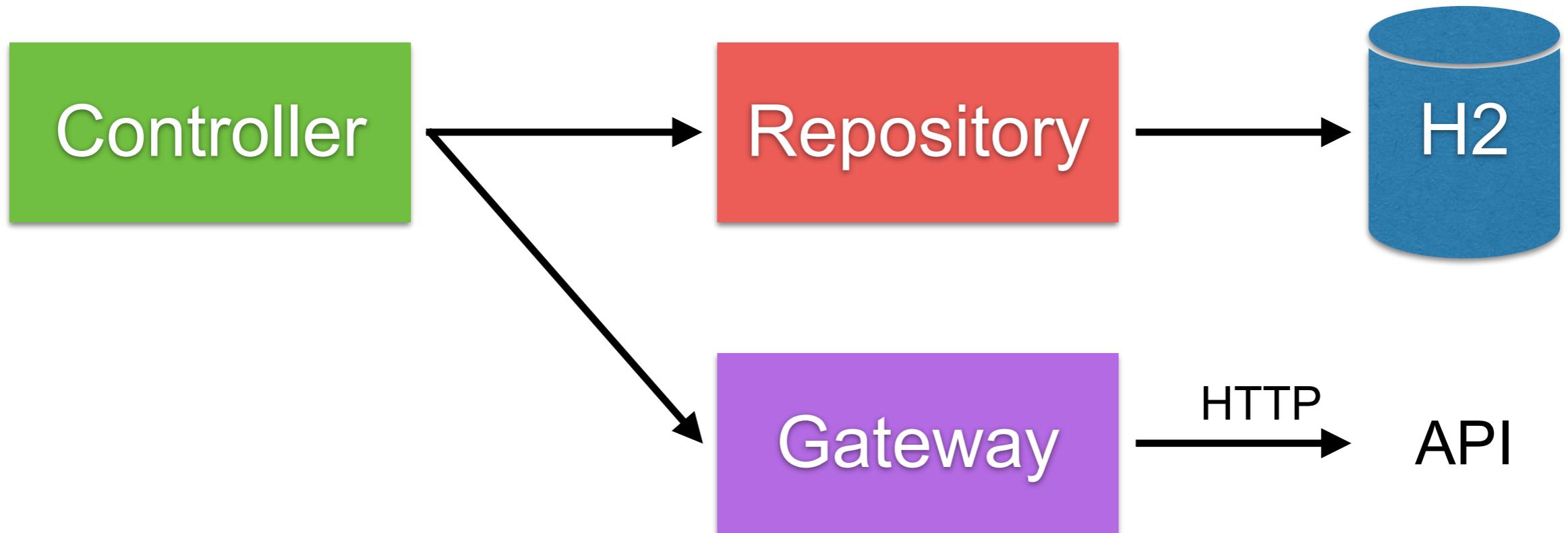


Postgre**SQ**L

Testing

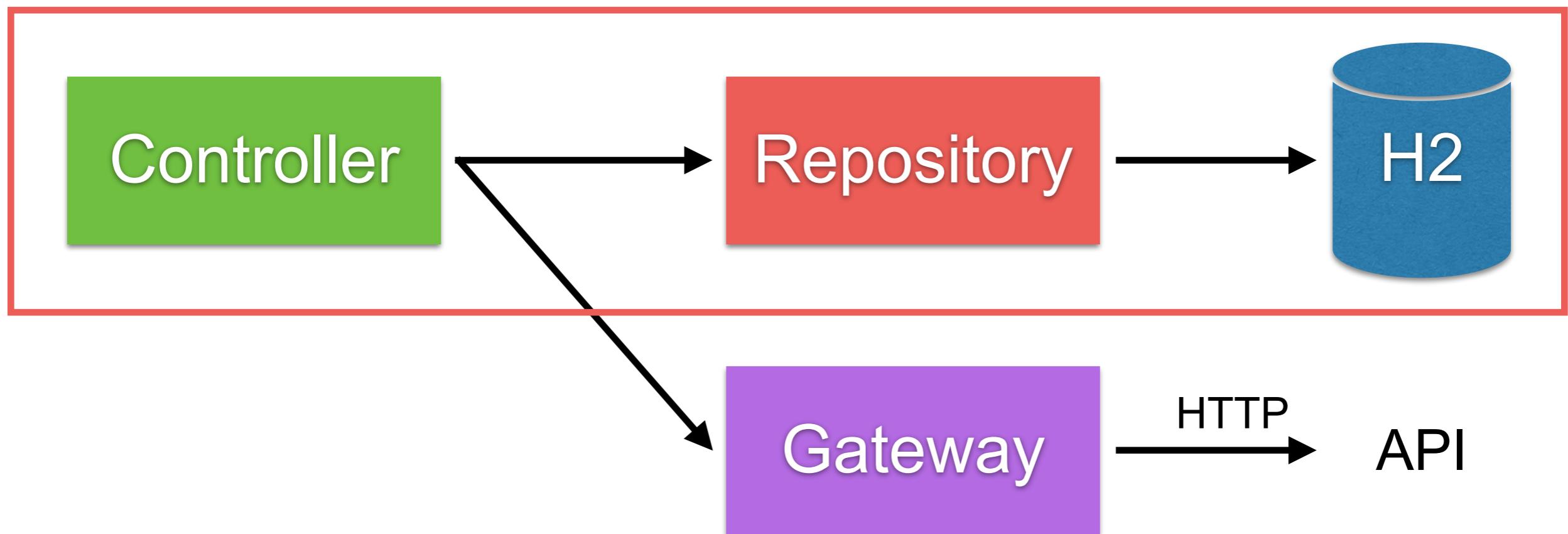


# Use cases



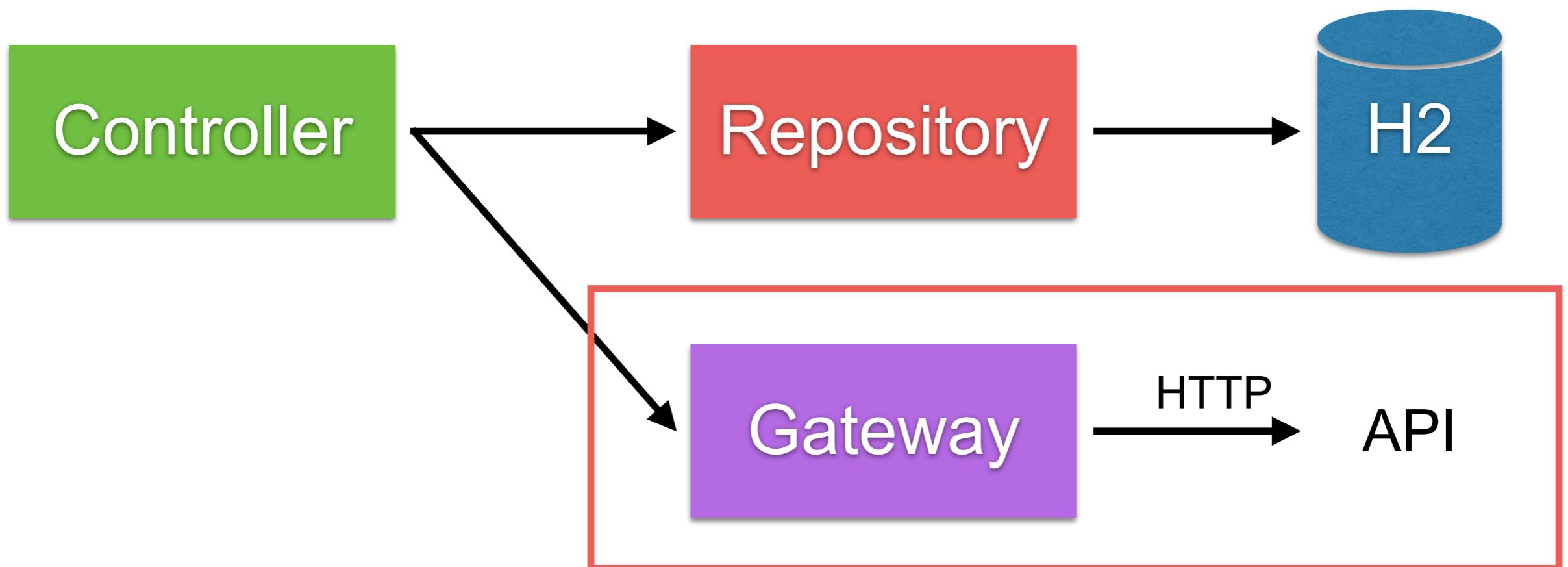
# Use case 1

## Working with repository



# Use case 2

## Working with API



# Use case 1



# Use case 1

## Working with repository

3. HelloController



2. PersonRepository



Controller

Repository

H2



1. Person



# 1. Create Entity class

In package person

```
@Entity  
public class Person {  
  
    @Id  
    @GeneratedValue(strategy = GenerationType.AUTO)  
    private long id;  
    private String firstName;  
    private String lastName;  
  
    public Person() {  
    }  
}
```



# 2. Create repository with JPA

## PersonRepository.java

```
import java.util.Optional;  
  
import org.springframework.data.repository.CrudRepository;  
  
public interface PersonRepository  
    extends CrudRepository<Person, Long> {  
  
    Optional<Person> findByLastName(String lastName);  
  
}
```



# 2. Create repository with JPA

## PersonRepository.java

```
import java.util.Optional;  
  
import org.springframework.data.repository.CrudRepository;  
  
public interface PersonRepository  
    extends CrudRepository<Person, Long> {  
  
    Optional<Person> findByLastName(String lastName);  
}
```

*SELECT \* FROM Person WHERE LastName=?*

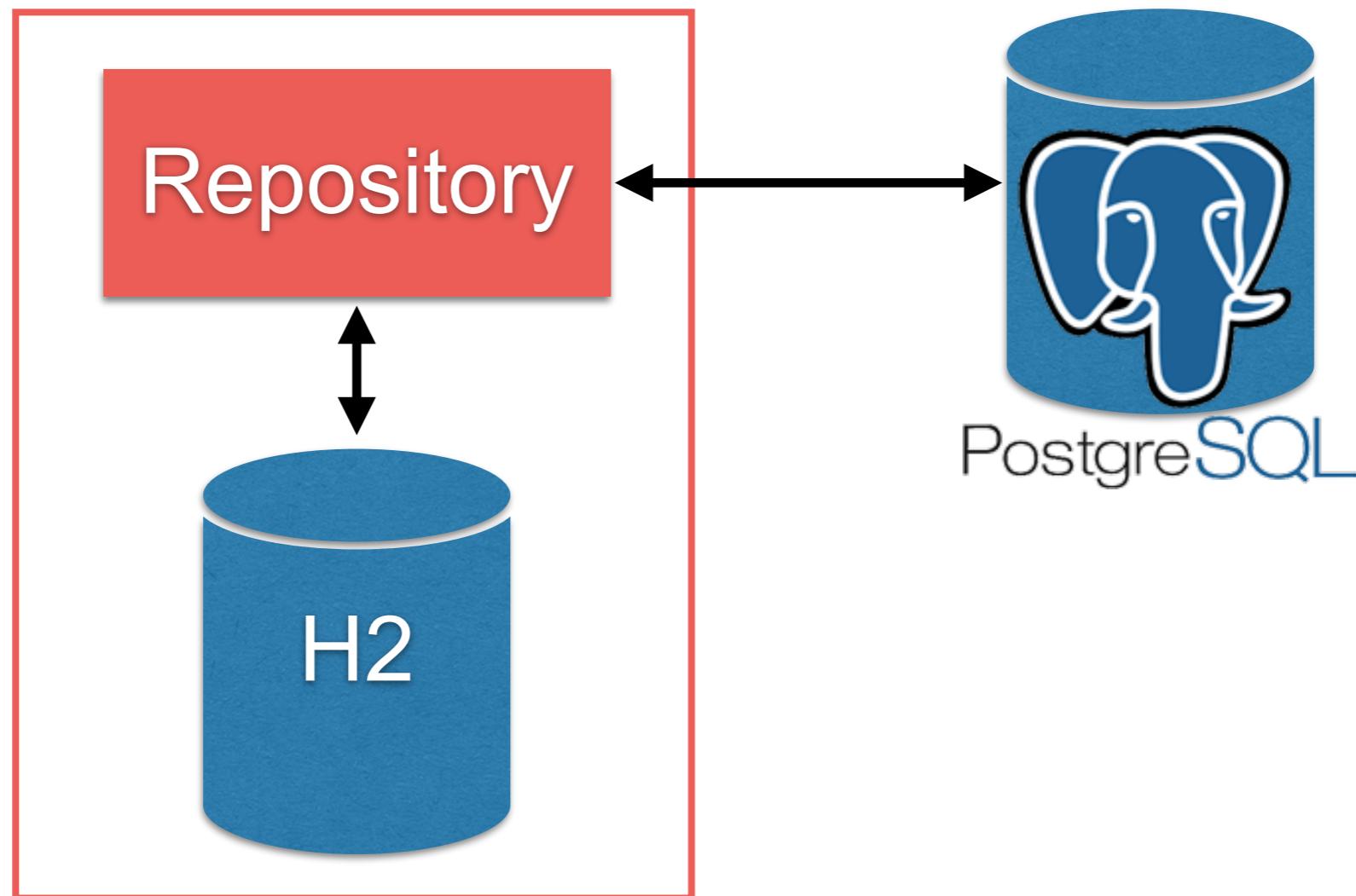


# How to testing repository ?



# Repository Testing

Using `@DataJpaTest` (slice testing)



Working with In-memory database



# Repository Testing #1

## Setup test with @DataJpaTest

```
@RunWith(SpringRunner.class)
@DataJpaTest
public class PersonRepositoryTest {

    @Autowired
    private PersonRepository repository;

    @After
    public void tearDown() throws Exception {
        repository.deleteAll();
    }

}
```



# Repository Testing #2

## Auto wired repository for testing

```
@RunWith(SpringRunner.class)
@DataJpaTest
public class PersonRepositoryTest {

    @Autowired
    private PersonRepository repository;

    @After
    public void tearDown() throws Exception {
        repository.deleteAll();
    }

}
```



# Repository Testing #3

Clear data in table after executed each test case

```
@RunWith(SpringRunner.class)
@DataJpaTest
public class PersonRepositoryTest {

    @Autowired
    private PersonRepository repository;

    @After
    public void tearDown() throws Exception {
        repository.deleteAll();
    }

}
```



# Repository Testing #3

Write your first test case

```
@Test  
public void should_save_fetch_a_person() {  
  
    Person somkiat = new Person("Somkiat", "Pui");  
    repository.save(somkiat);  
  
    Optional<Person> maybeSomkiat  
        = repository.findByLastName("Pui");  
  
    assertEquals(maybeSomkiat, Optional.of(somkiat));  
}
```



# Run test

\$mvnw clean test

Hibernate: drop table person if exists

Hibernate: drop sequence if exists hibernate\_sequence

Hibernate: create sequence hibernate\_sequence start with 1 increment by 1

Hibernate: create table person (id varchar(255) not null, first\_name varchar(255), last\_name varchar(255), primary key (id))

Insert data

Hibernate: call next value for hibernate\_sequence

Hibernate: insert into person (first\_name, last\_name, id) values (?, ?, ?)

Hibernate: select person0\_.id as id1\_0\_, person0\_.first\_name as first\_na2\_0\_, person0\_.last\_name as last\_nam3\_0\_ from person person0\_ where person0\_.last\_name=?

Hibernate: select person0\_.id as id1\_0\_, person0\_.first\_name as first\_na2\_0\_, person0\_.last\_name as last\_nam3\_0\_ from person person0\_

2

Query data

Hibernate: drop table person if exists

Hibernate: drop sequence if exists hibernate\_sequence



# Use case 1

Integrate repository with controller

3. HelloController



2. PersonRepository



4. PersonResponse

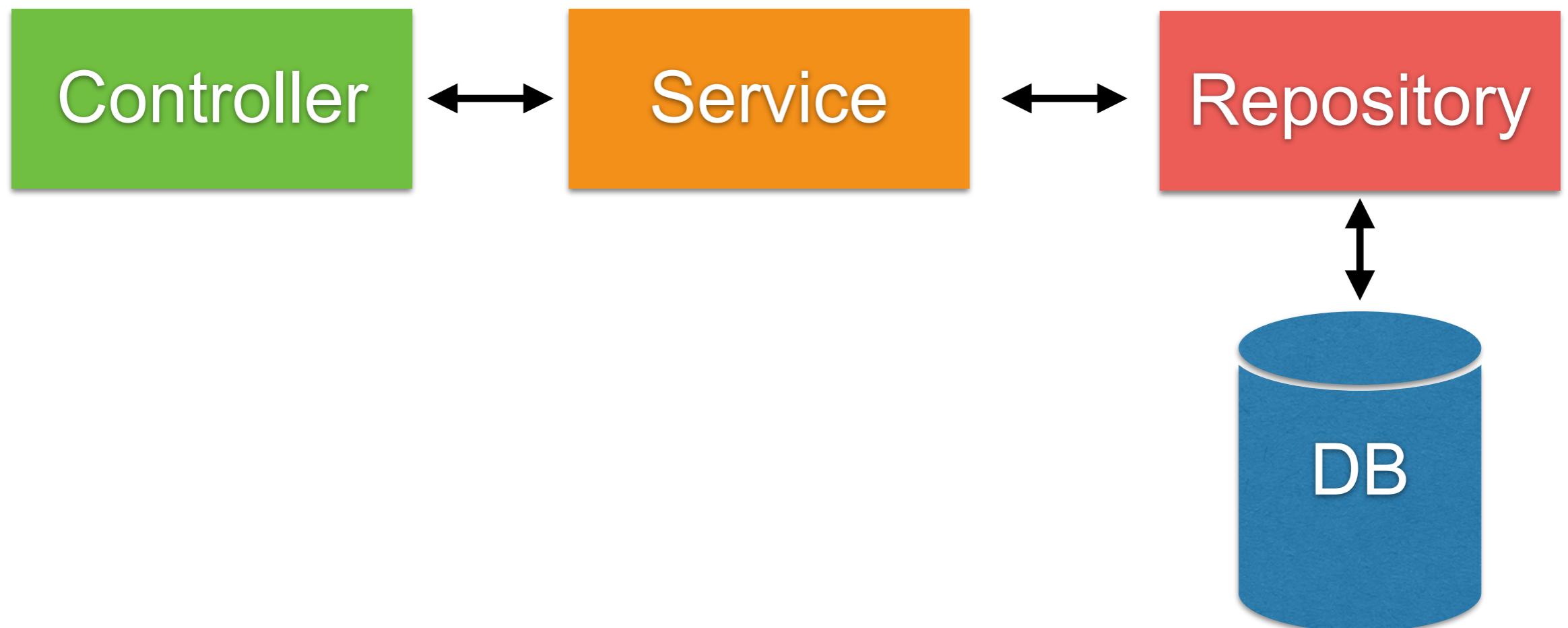
1. Person



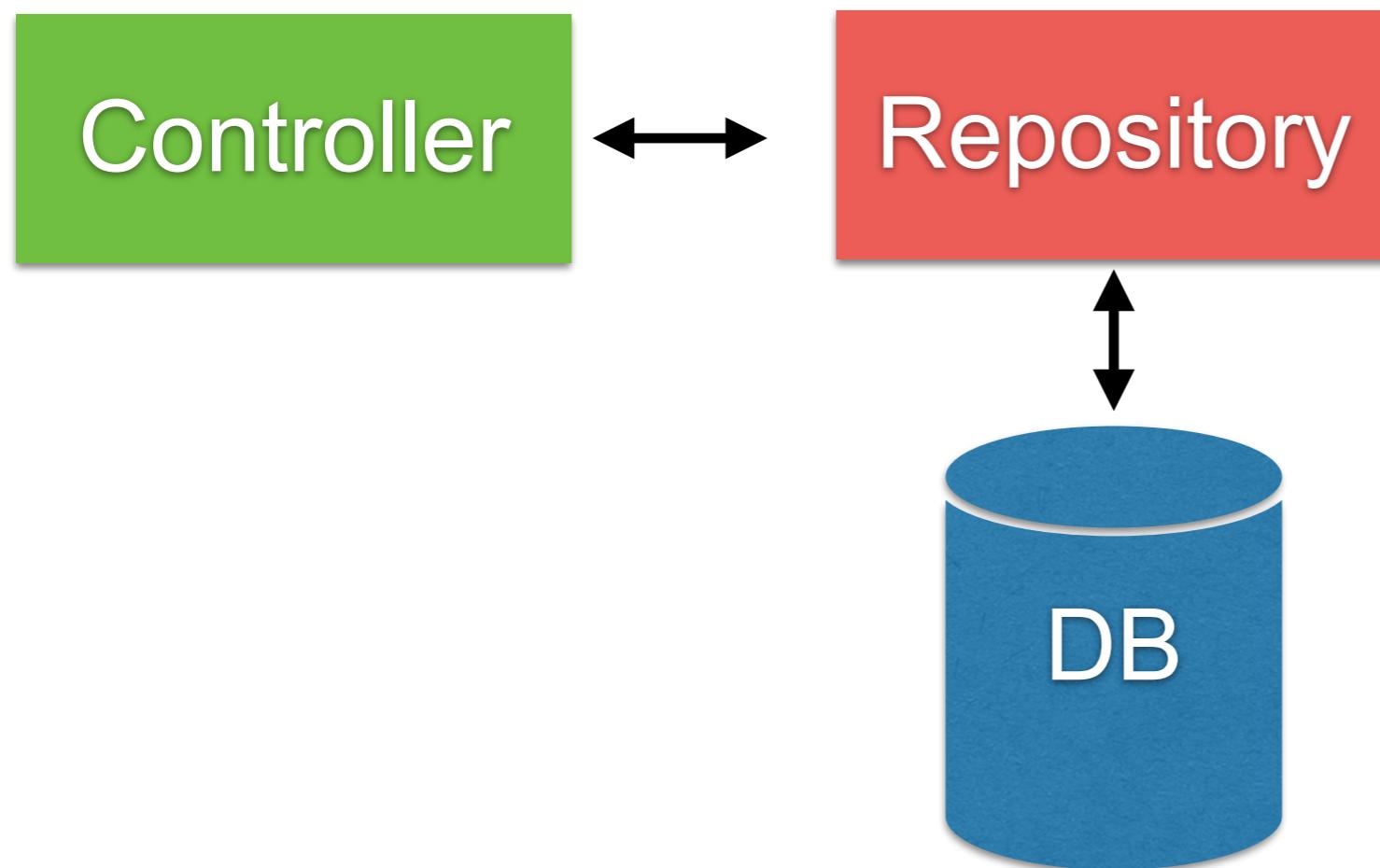
# Integrate repository with service/controller



# Service use repository ?



# Controller use repository ?



# Controller call repository

## Create HelloController.java

```
@RestController
public class HelloController {

    private final PersonRepository personRepository;

    @Autowired
    public HelloController(final PersonRepository personRepository) {
        this.personRepository = personRepository;
    }
}
```



# Controller call repository

## Create HelloController.java

```
@GetMapping("/hello/{lastName}")
public HelloResponse hello(@PathVariable final String lastName) {

    Optional<Person> foundPerson
        = personRepository.findByLastName(lastName);

    return foundPerson
        .map(person ->
            new HelloResponse(person.getFirstName(),
                person.getLastName()))
        .orElseThrow(() -> new RuntimeException());
}
```



# Run spring boot

\$mvnw spring-boot:run



# Fix !!!

## Modify src/main/resources/application.properties

server.port=8088

spring.datasource.url=jdbc:postgresql://127.0.0.1:15432/postgres

spring.datasource.username=testuser

spring.datasource.password=password

spring.datasource.platform=POSTGRESQL

spring.jpa.show-sql=true

spring.jpa.hibernate.ddl-auto=create-drop

spring.jpa.database-platform=org.hibernate.dialect.PostgreSQLDialect

## Start database server !!



# Fix !!!

Modify pom.xml

Delete or comment postgresql dependency

```
<dependency>
    <groupId>com.h2database</groupId>
    <artifactId>h2</artifactId>
    <scope>runtime</scope>
</dependency>

<!-- <dependency>
    <groupId>org.postgresql</groupId>
    <artifactId>postgresql</artifactId>
    <scope>runtime</scope>
</dependency> -->
```



# Run spring boot

\$mvnw spring-boot:run

localhost:8088/hello/somkiat

## Whitelabel Error Page

This application has no explicit mapping for /error, so you are seeing this as

Tue Mar 05 23:33:48 ICT 2019

There was an unexpected error (type=Internal Server Error, status=500).

No message available



# Initial data in database



# Initial database #1

## Using @Bean and CommandLineRunner

```
@Bean  
public CommandLineRunner initData(MessageRepository repository) {  
    return new CommandLineRunner() {  
  
        @Override  
        public void run(String... args) throws Exception {  
            repository.save(new Message("somkiat1"));  
            repository.save(new Message("somkiat2"));  
        }  
    };  
}
```



# Initial database #2

## Using @PostConstruct

```
@PostConstruct  
public void initData() {  
    Account account1 = new Account();  
    account1.setAccountId("01");  
    accountRepository.save(account1);  
    Account account2 = new Account();  
    account2.setAccountId("02");  
    accountRepository.save(account2);  
}
```



# Initial database #3

**Schema** (resources/schema.sql)

**Data** (resources/data.sql)

## Schema.sql

```
CREATE TABLE account(
    id BIGINT AUTO_INCREMENT PRIMARY KEY,
    account_Id VARCHAR(16) NOT NULL UNIQUE,
    mobile_No VARCHAR(10),
    name VARCHAR(50),
    account_Type CHAR(2)
);
```

## Data.sql

```
INSERT INTO account (account_Id) VALUES ('01');
INSERT INTO account (account_Id) VALUES ('02');
```



# Initial database 2

Disable auto generate DDL from JPA in file application.yml

```
spring:  
  jpa:  
    show-sql: true  
    hibernate:  
      ddl-auto: none
```



# Initial database 2

## Problem with naming strategy !!

```
spring:  
  jpa:  
    show-sql: true  
    hibernate:  
      ddl-auto: none  
      naming:  
        physical-strategy:  
          org.springframework.boot.orm.jpa.hibernate.SpringPhysicalNamingStrategy  
        implicit-strategy:  
          org.springframework.boot.orm.jpa.hibernate.SpringImplicitNamingStrategy
```

<https://github.com/spring-projects/spring-boot/tree/master/spring-boot-project/spring-boot/src/main/java/org/springframework/boot/orm/jpa/hibernate>



# Run and see from logging

Execute file schema.sql and data.sql

```
.datasource.init.ScriptUtils      : Executing SQL script from URL [file:/Users/somki...  
.datasource.init.ScriptUtils      : Executed SQL script from URL [file:/Users/somki...  
.datasource.init.ScriptUtils      : Executing SQL script from URL [file:/Users/somki...  
.datasource.init.ScriptUtils      : Executed SQL script from URL [file:/Users/somki...
```



# Run spring boot

\$mvnw spring-boot:run



# **Write controller testing ?**

**\$mvnw clean test**

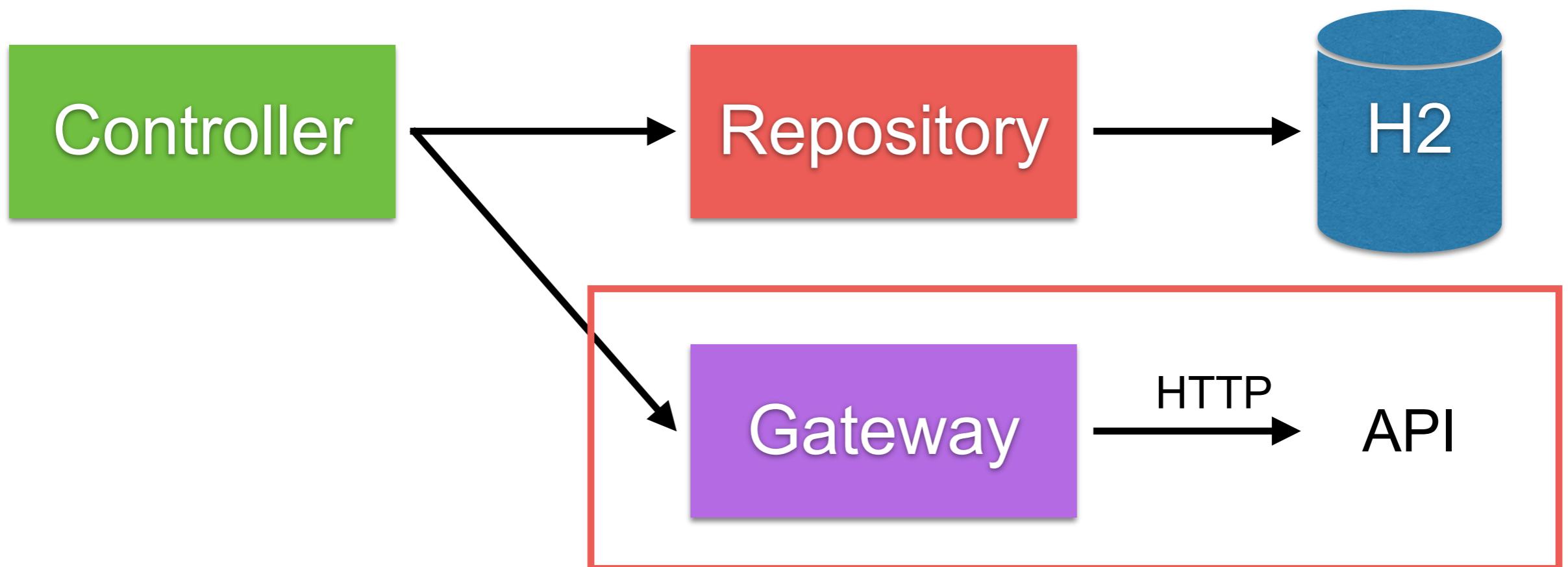


# Use case 2



# Use case 2

## Working with API



# JSON Place Holder

<https://jsonplaceholder.cypress.io/posts/1>

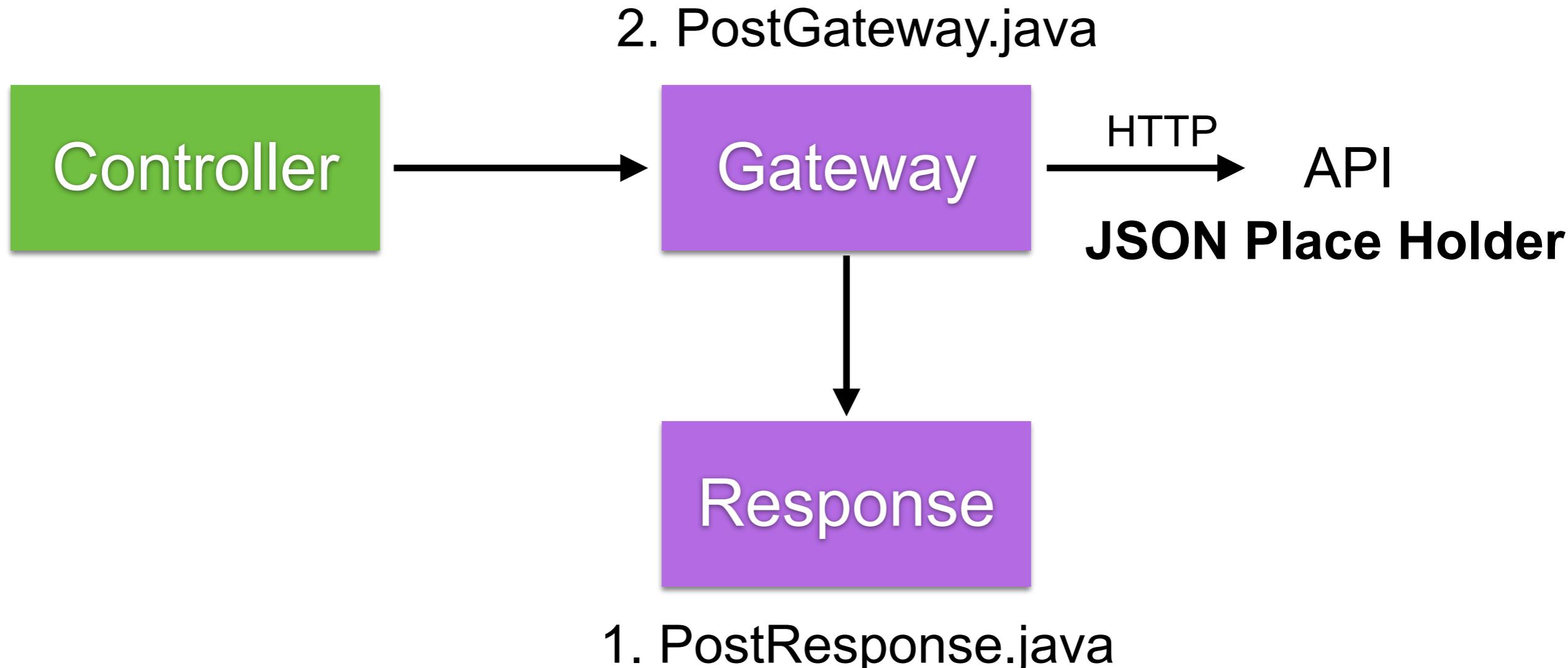
The screenshot shows a web-based API testing interface for JSONPlaceholder. At the top, the title "JSONPlaceholder" is displayed in large, bold letters. Below it, a subtitle reads "Fake Online REST API for Testing and Prototyping" and "Powered by [JSON Server + LowDB](#)". A code snippet in a light gray box illustrates a JavaScript fetch call:

```
fetch('https://jsonplaceholder.cypress.io/todos/1')
  .then(response => response.json())
  .then(json => console.log(json))
```

At the bottom of the interface is a blue button labeled "Try it".



# Working with API



# 1. Create Response class

In package post

```
public class PostResponse {  
    private int id;  
    private int userId;  
    private String title;  
    private String body;
```



# 2. Create PostGateway class #1

In package post

```
@Component
public class PostGateway {

    private final RestTemplate restTemplate;
    private final String postApiUrl;

    @Autowired
    public PostGateway(final RestTemplate restTemplate,
                       @Value("${post.api.url}") final String postApiUrl) {
        this.restTemplate = restTemplate;
        this.postApiUrl = postApiUrl;
    }
}
```



# 2. Create PostGateway class #1

In package post

```
@Component
public class PostGateway {

    private final RestTemplate restTemplate;
    private final String postApiUrl;

    @Autowired
    public PostGateway(final RestTemplate restTemplate,
    @Value("${post.api.url}") final String postApiUrl) {
        this.restTemplate = restTemplate;
        this.postApiUrl = postApiUrl;
    }
}
```

Configuration ?



# Configuration

Configuration in file application.properties

```
post.api.url=https://jsonplaceholder.cypress.io
```



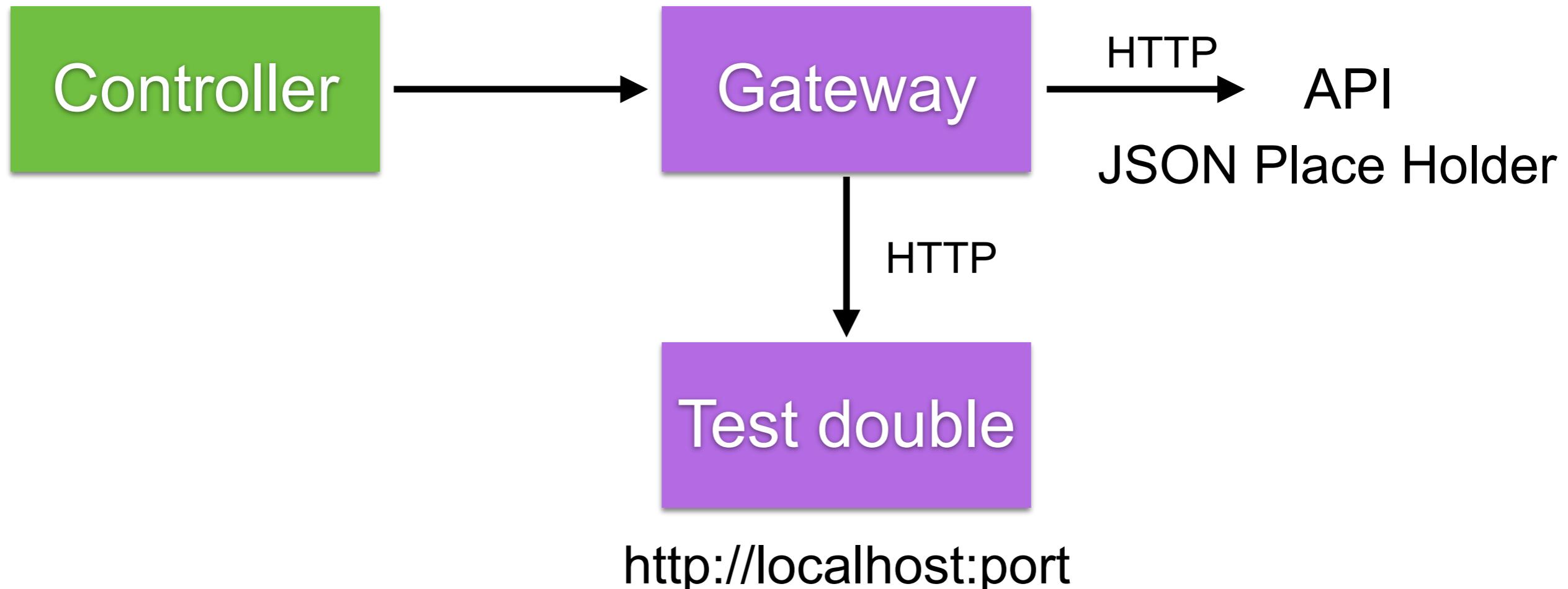
# 2. Create PostGateway class #2

Get data from API

```
public Optional<PostResponse> getPostById(int id) {  
    String url = String.format("%s/posts/%d", postApiUrl, id);  
  
    try {  
        return Optional.ofNullable(  
            restTemplate.getForObject(url, PostResponse.class));  
    } catch (RestClientException e) {  
        return Optional.empty();  
    }  
}
```



# Testing with API



# Testing with API

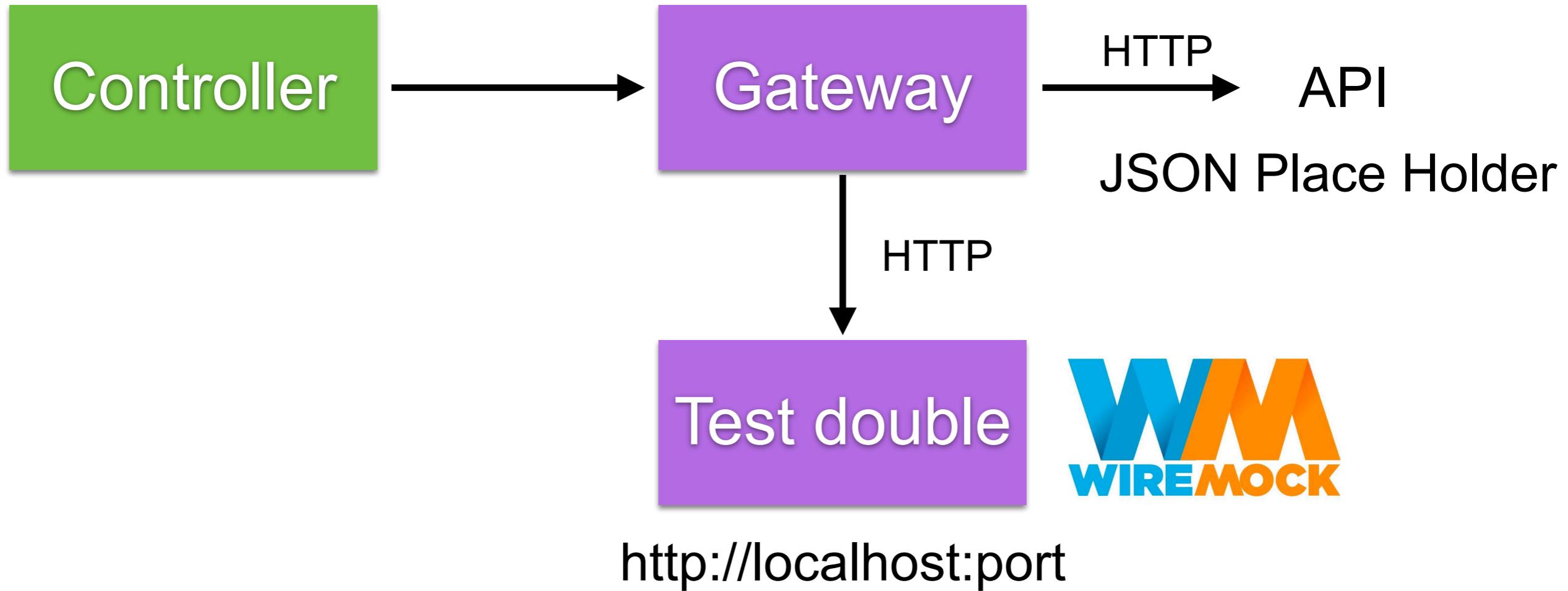
Unit testing with Mockito

**Component testing with WireMock**

Consumer testing with Pact



# Component testing with WireMock



**/src/test/resources/application.properties**

```
post.api.url=http://localhost:9999
```



# Component testing #1

## Working with WireMock

```
@RunWith(SpringRunner.class)
@SpringBootTest(webEnvironment = WebEnvironment.RANDOM_PORT)
@AutoConfigureWireMock(port = 9999)
public class PostGatewayComponentTest {

    @Autowired
    private PostGateway postGateway;
```

*“Default port = 9999”*



# Component testing #2

## Success case

```
@Test  
public void getPostById() throws IOException {  
    stubFor(get(urlPathEqualTo("/posts/1"))  
        .willReturn(aResponse()  
            .withBody(read("classpath:postApiResponse.json"))  
            .withHeader(CONTENT_TYPE, MediaType.APPLICATION_JSON_VALUE)  
            .withStatus(200));  
}
```

Stub response

```
Optional<PostResponse> postResponse = postGateway.getPostById(1);  
assertEquals(11, postResponse.get().getId());  
assertEquals(11, postResponse.get().getUserId());  
assertEquals("Test Title", postResponse.get().getTitle());  
assertEquals("Test Body", postResponse.get().getBody());  
}
```



# Component testing #3

## Read data from resources folder

```
public static String read(String filePath) throws IOException {  
    File file = ResourceUtils.getFile(filePath);  
    return new String(Files.readAllBytes(file.toPath()));  
}
```



# Component testing #4

## File postApiResponse.json

```
{  
  "userId": 11,  
  "id": 11,  
  "title": "Test Title",  
  "body": "Test Body"  
}
```



# **Write controller testing ?**

**\$mvnw clean test**



# Separate tests with jUnit



<https://semaphoreci.com/community/tutorials/how-to-split-junit-tests-in-a-continuous-integration-environment>



# Separate test with jUnit



# Working with jUnit Category

Create interface in each category

```
package com.lotto.lotto.category;  
  
public interface UnitTest {  
}
```

```
package com.lotto.lotto.category;  
  
public interface SlicingTest {  
}
```

```
package com.lotto.lotto.category;  
  
public interface IntegrationTest {  
}
```



# Add category in each test class

```
@RunWith(SpringRunner.class)
@SpringBootTest(webEnvironment = WebEnvironment.RANDOM_PORT)
@Category(IntegrationTest.class)
public class AccountControllerTest {

    @Autowired
    private TestRestTemplate testRestTemplate;

    @MockBean
    private UserService userService;
```



# Run with category

```
$mvnw clean test  
-Dgroups="com.lotto.lotto.category.UnitTest"
```



# Aspect-Oriented Programming

## AOP



# Aspects ?

Reusable blocks of code that are injected into application at runtime

Powerful tools for adding behavior

Solve cross-cutting concerns in one place



# Common Applications of Aspects

Logging  
Transaction management  
Caching  
Security



# Why use Aspects ?

Reduce code duplication

DRY (Don't Repeat Yourself)

Maintain application logic



# Parts of Spring Aspect

Join Point  
Pointcut  
Advice  
Aspect



# Working with transaction



# Working with logging



# Are you too busy to improve?



Thank you  
Q/A

