สยามชำนาญกิจ
SIAM CHAMNAN KIT

Spring Framework

Introduction

Introduction

Spring Framework

Spring Boot

Spring Data

Spring Testing

Spring Framework

- Introduction to Spring Framework
- Deep dive into Spring Framework
- Inversion of Control (IoC)
- Dependency Injection
- Beans and BeanFactory

Spring Boot

- RESTful API
- Building RESTful API with Spring Boot
- Spring Boot with Spring Data JPA
- Testing with Spring Boot

Introduction to Spring Framework

What is Spring Framework ?

Application development framework
for Java, Kotlin and Groovy

What is Spring Framework ?

Easy and safe
High productivity
Integrate with new technologies
Testable application
Speed up delivery

Spring projects

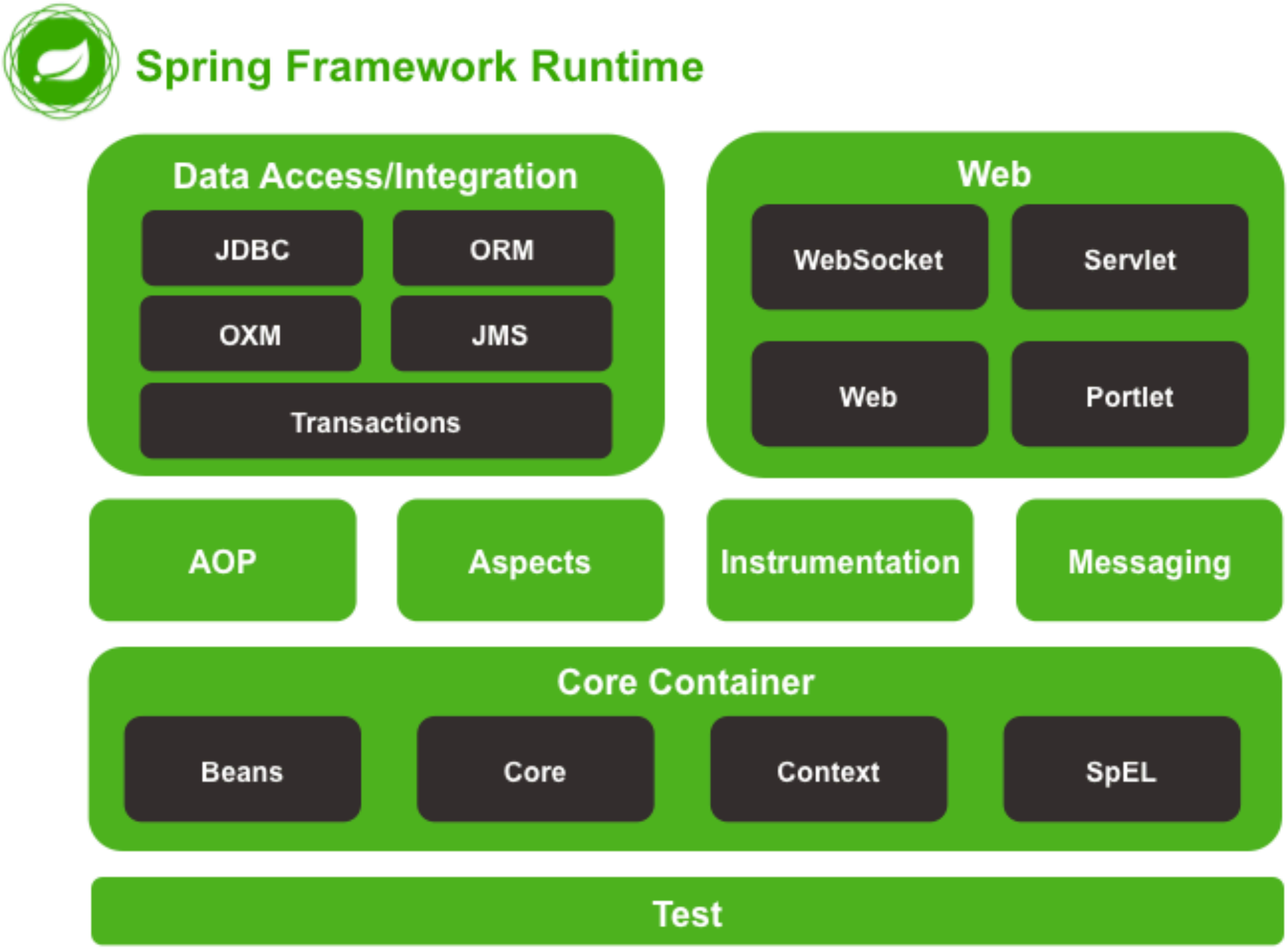
Spring Projects

Modular by design

Spring Framework	Spring Boot	Spring Cloud 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

Overview of Spring Framework



Deep Dive
Spring Framework

Core container

Beans
Core
Container or Spring Container

Beans

Beans

Unit of work

Spring container manages one of 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
Lazy initialization mode	Lazy-initialized beans

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

Bean Scopes

Scope	Description
singleton	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

How to create bean ?

BeanFactory ?

Interface defines basic functionality for Spring container

Factory design pattern

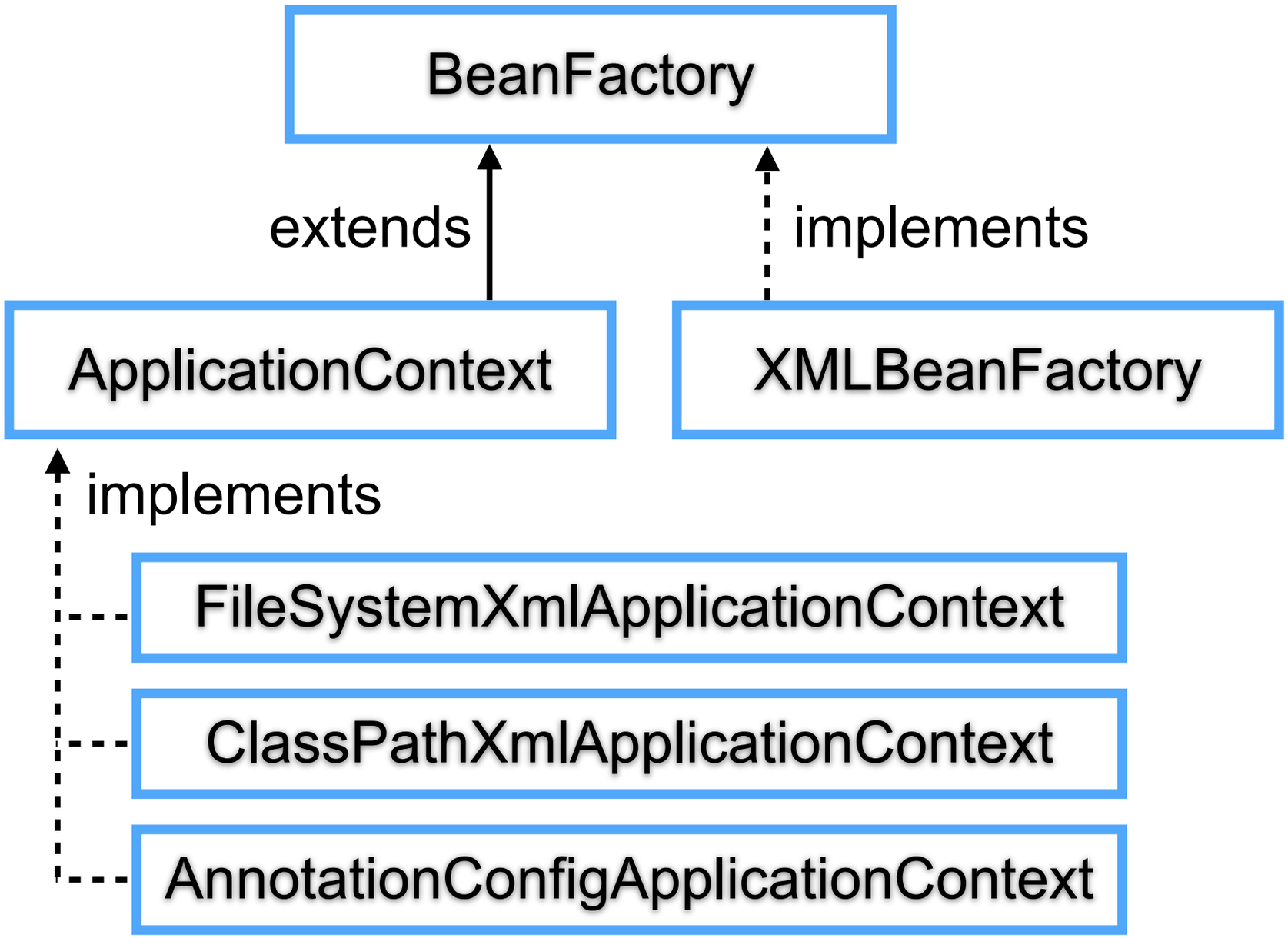
Load beans from configuration source

Instantiated the bean when requested

Wire dependencies and properties for beans

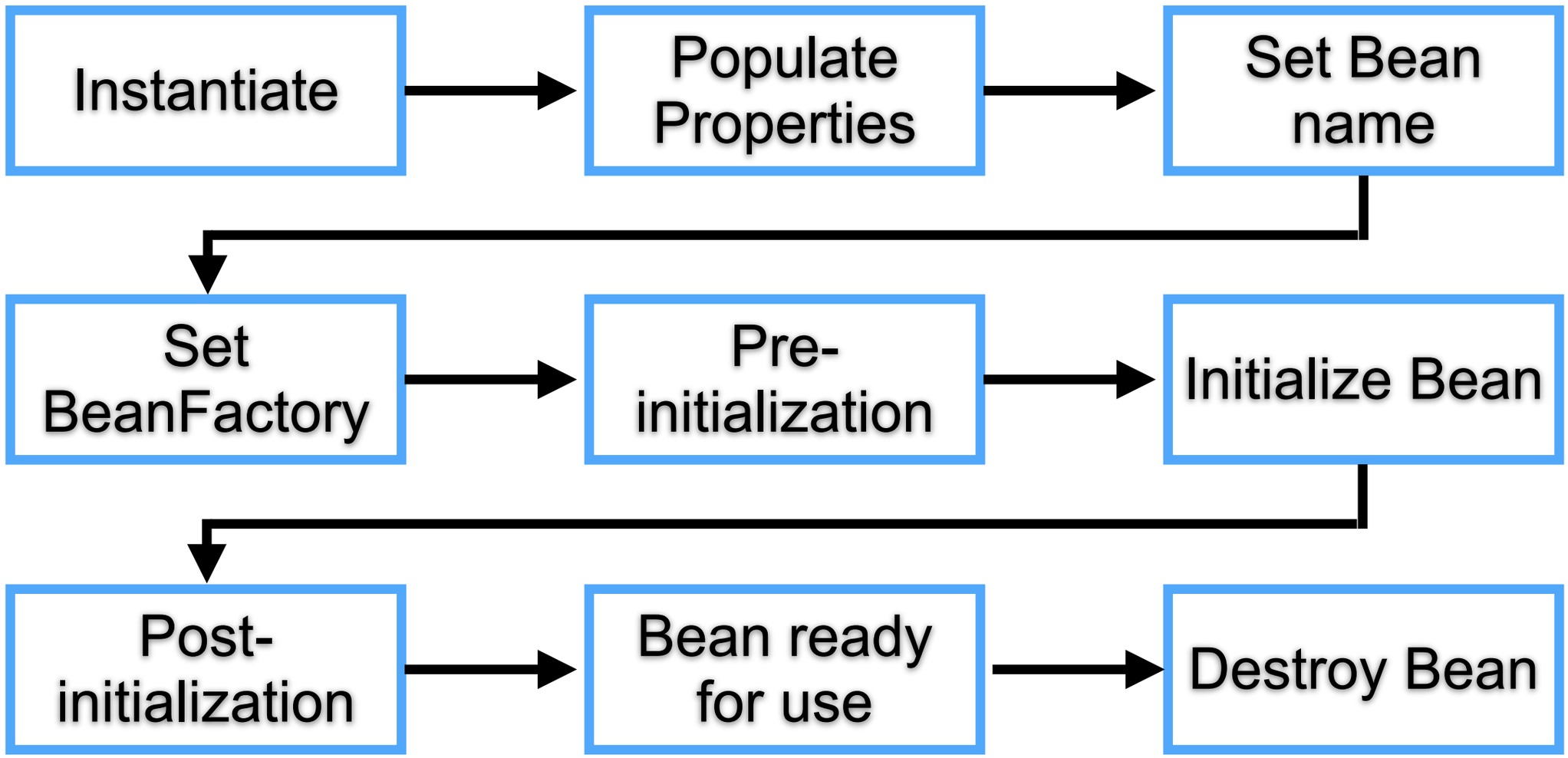
Manage the bean lifecycle

BeanFactory ?



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

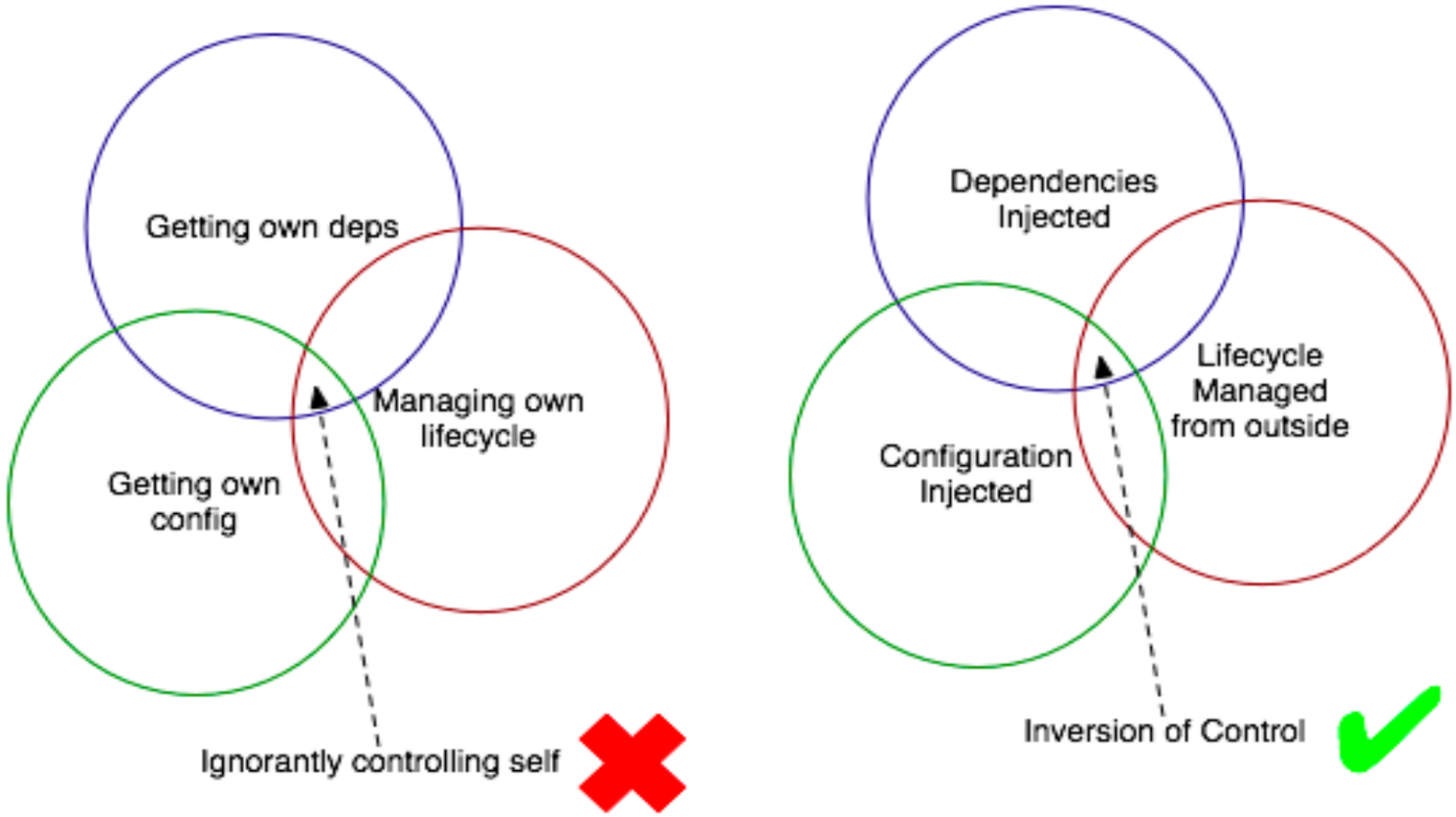
Lifecycle of BeanFactory



Cores

Core

Provide the fundamental parts of framework
Including **IoC** and **Dependency Injection**



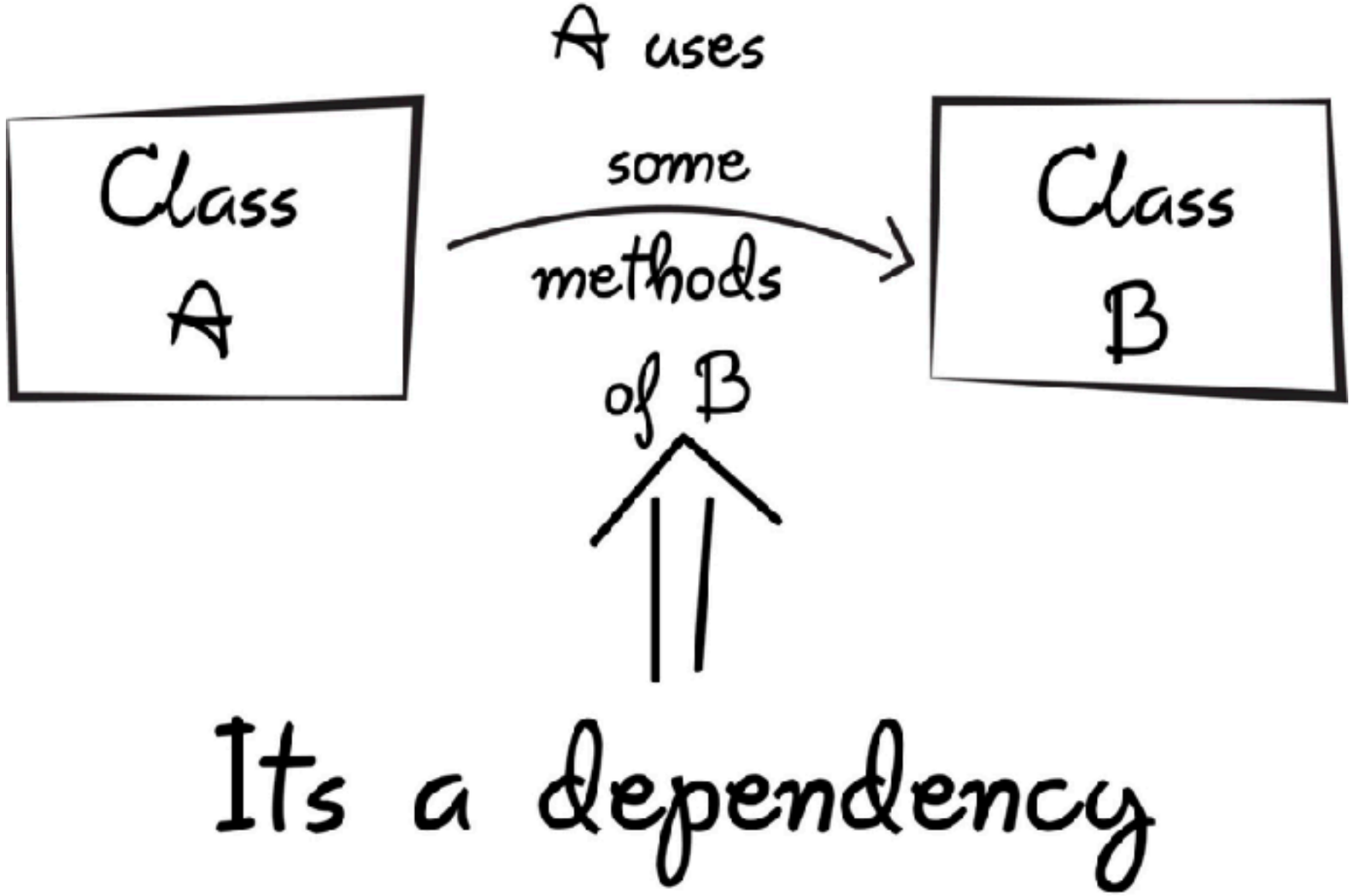
https://www.martinfowler.com/articles/injection.html

Inversion of Control (IoC)

Concept in application development

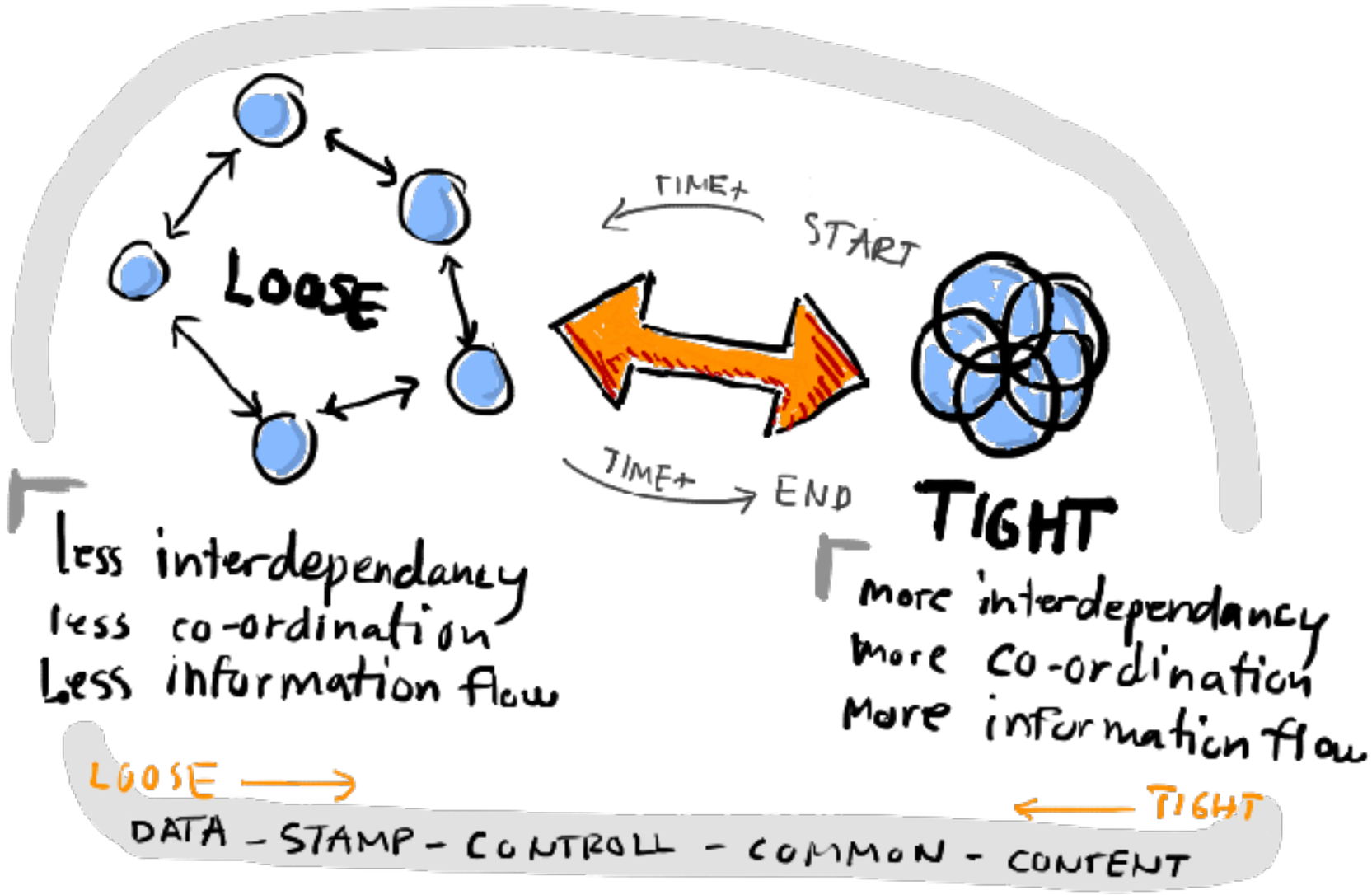
Don’t call me, I will call you

Dependency Injection



Understanding Dependency Injection

Tight coupling
Loose coupling

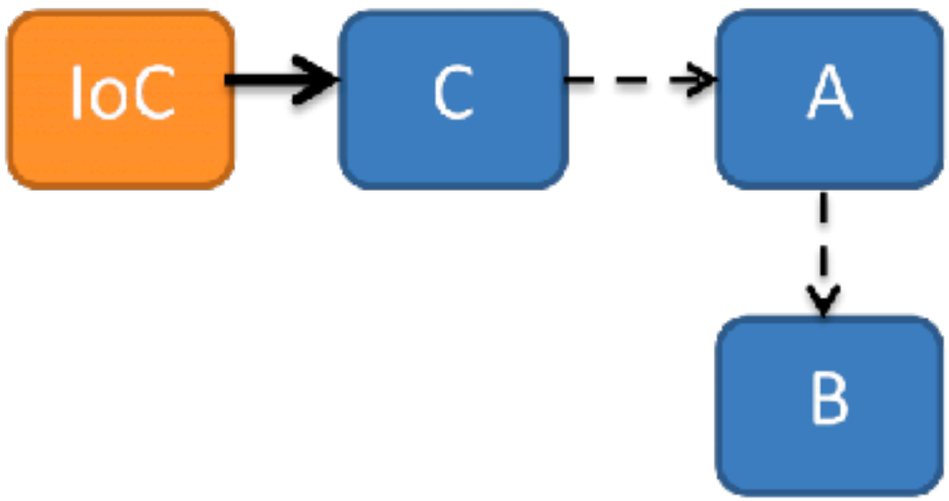


Dependency Injection

Class Dependencies

Service Location / Active Calling

IoC / DI / Auto-Wiring / Passive Calling

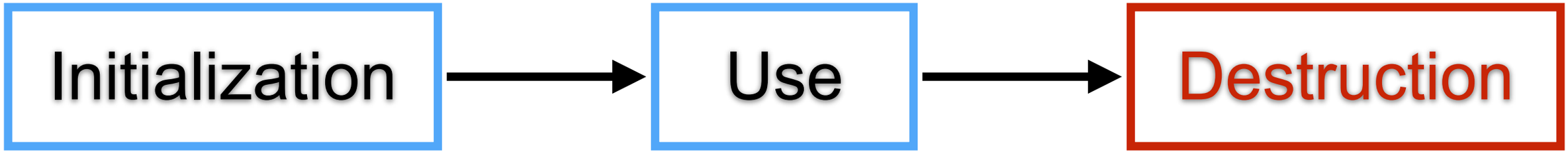


Types of Dependency Injection

Constructor injection
Property/Setter injection
Method injection
Interface injection

Container

Application Lifecycle

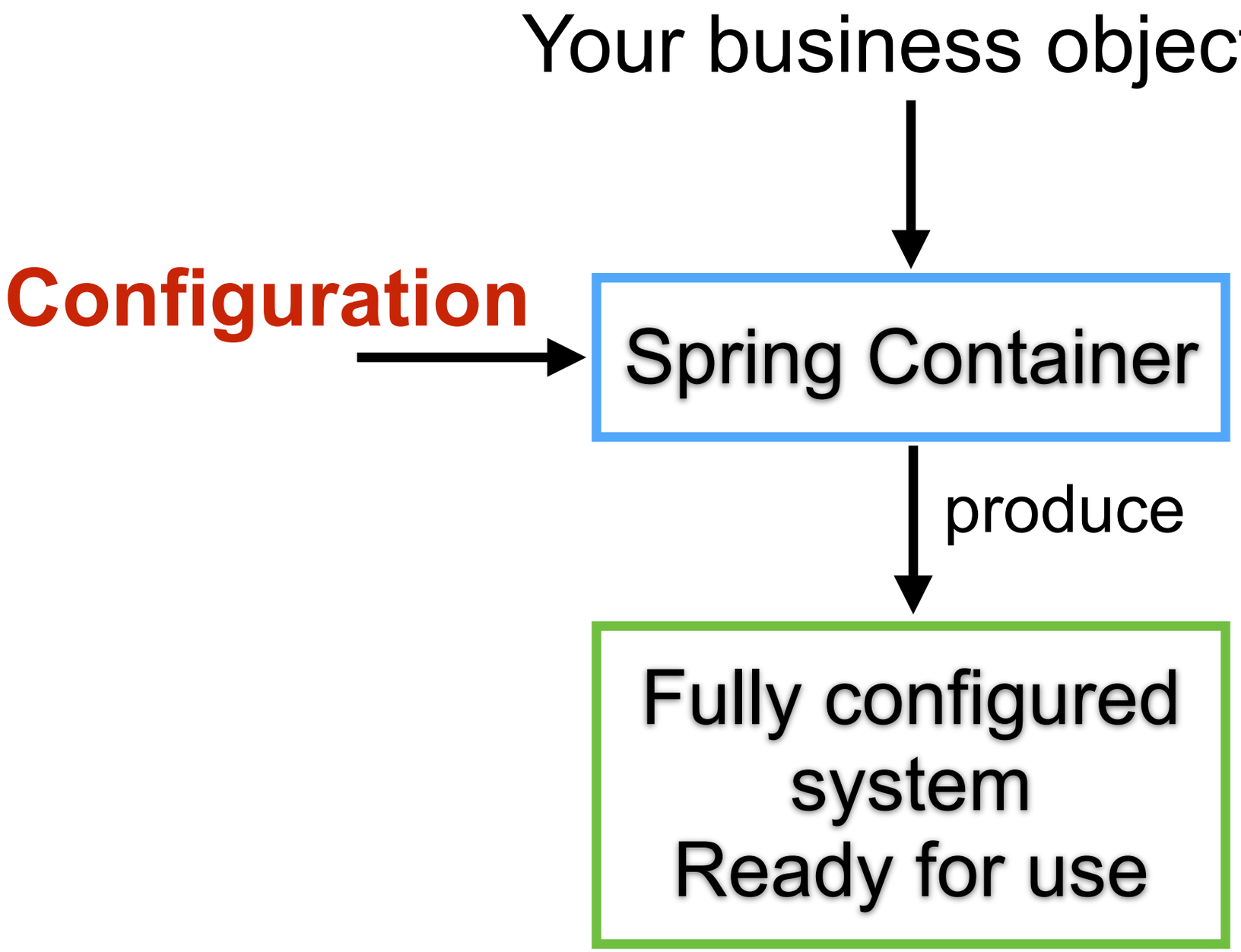


Create services
Allocate resources

Process by requests

Shutdown
Release resources

Spring IoC container



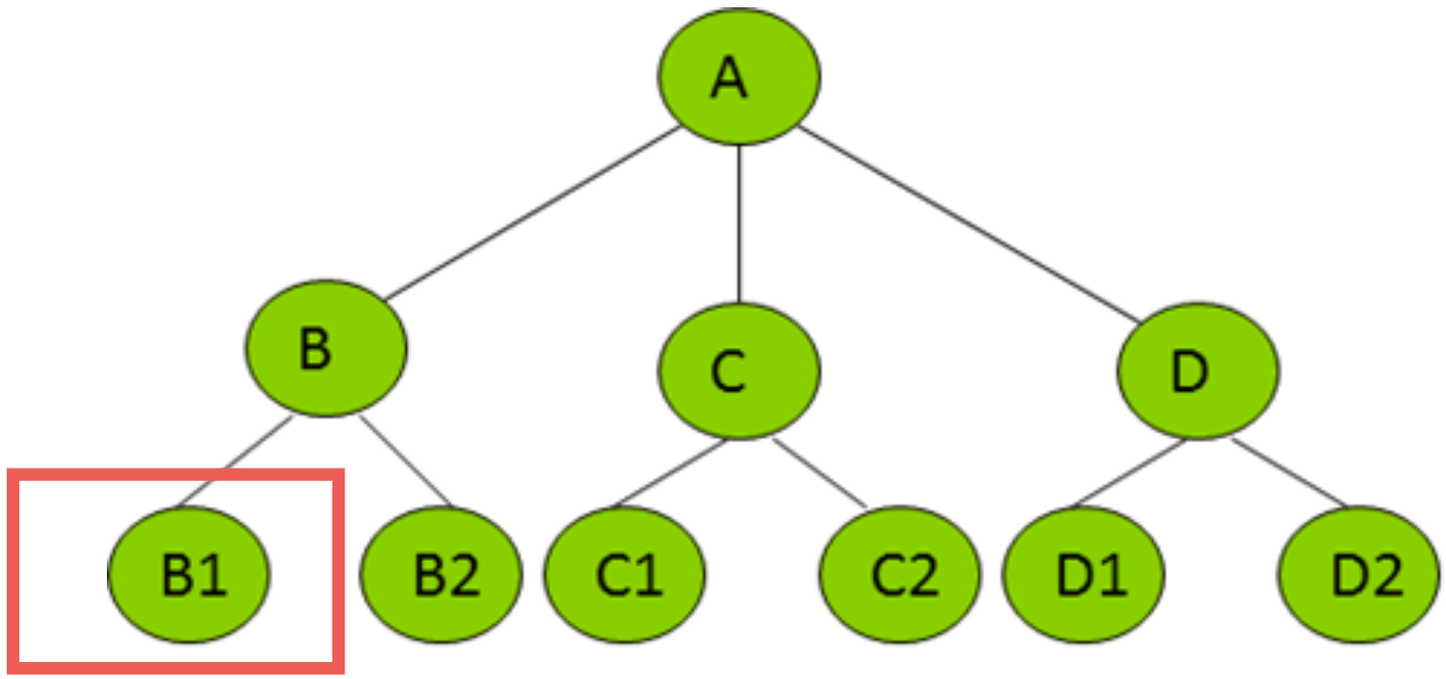
Configuration

From XML file

Annotation-based configuration (2.5)

Java-based configuration (3.0)

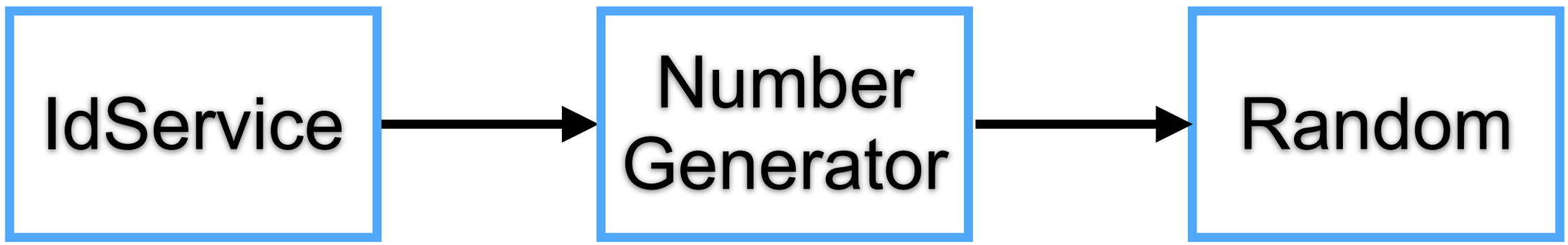
Spring IoC container



Bean B1

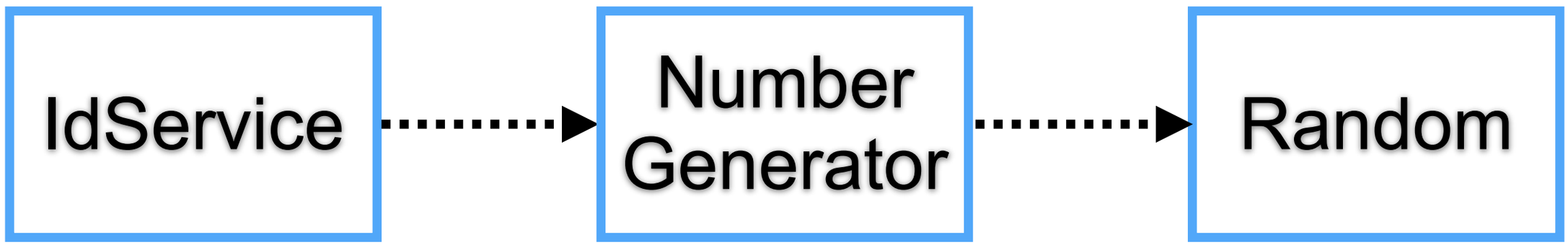
Demo IoC and DI with Java

Structure



Demo IoC and DI with Spring

Structure

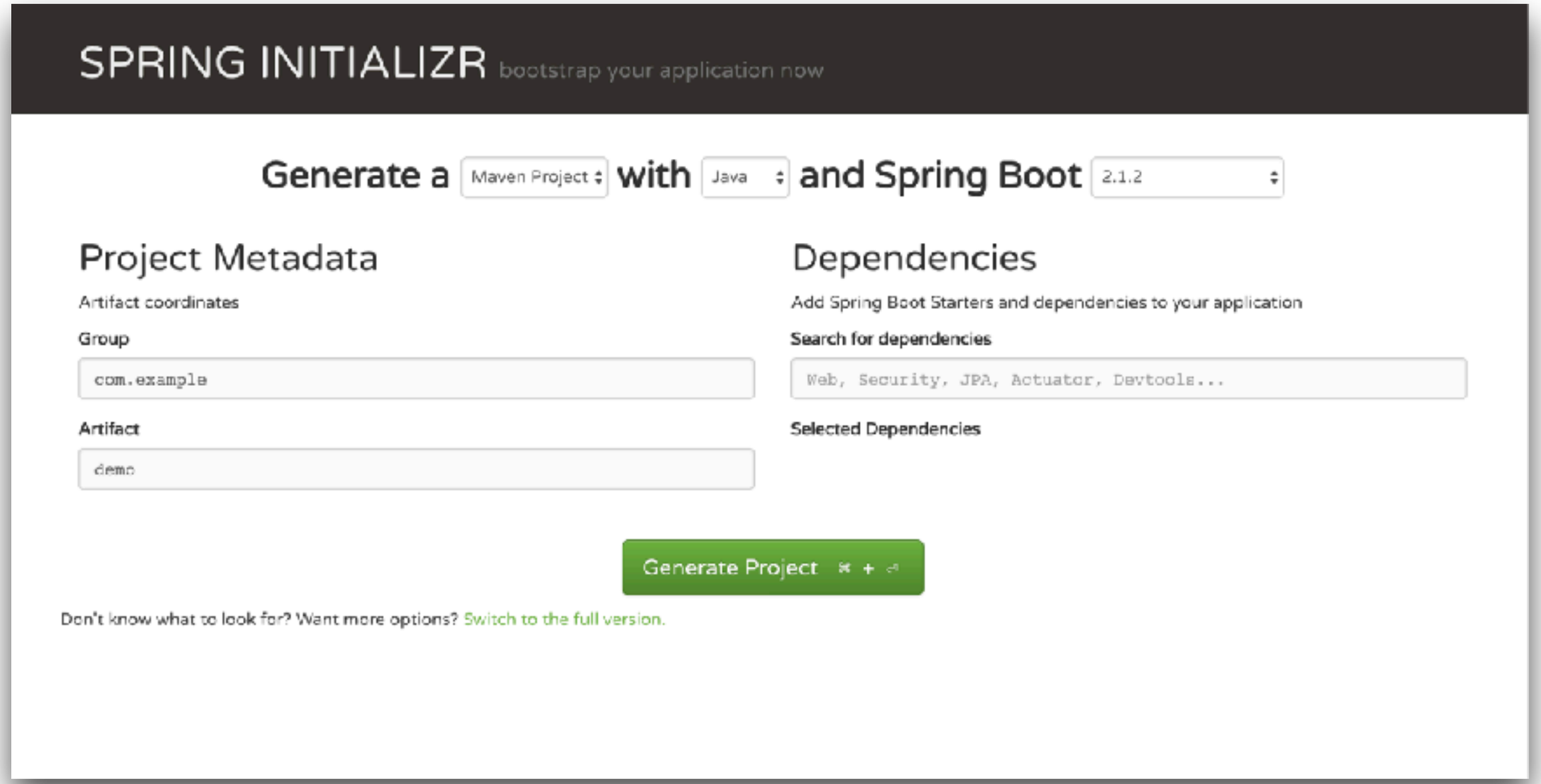


Back to Spring Framework

Let’s start Spring Framework

Create new Project

Use **spring initializr**



https://start.spring.io/

Using Spring to manage dependencies

@Component

@Autowired

Constructor and Setter injection

@Primary

@Qualifier

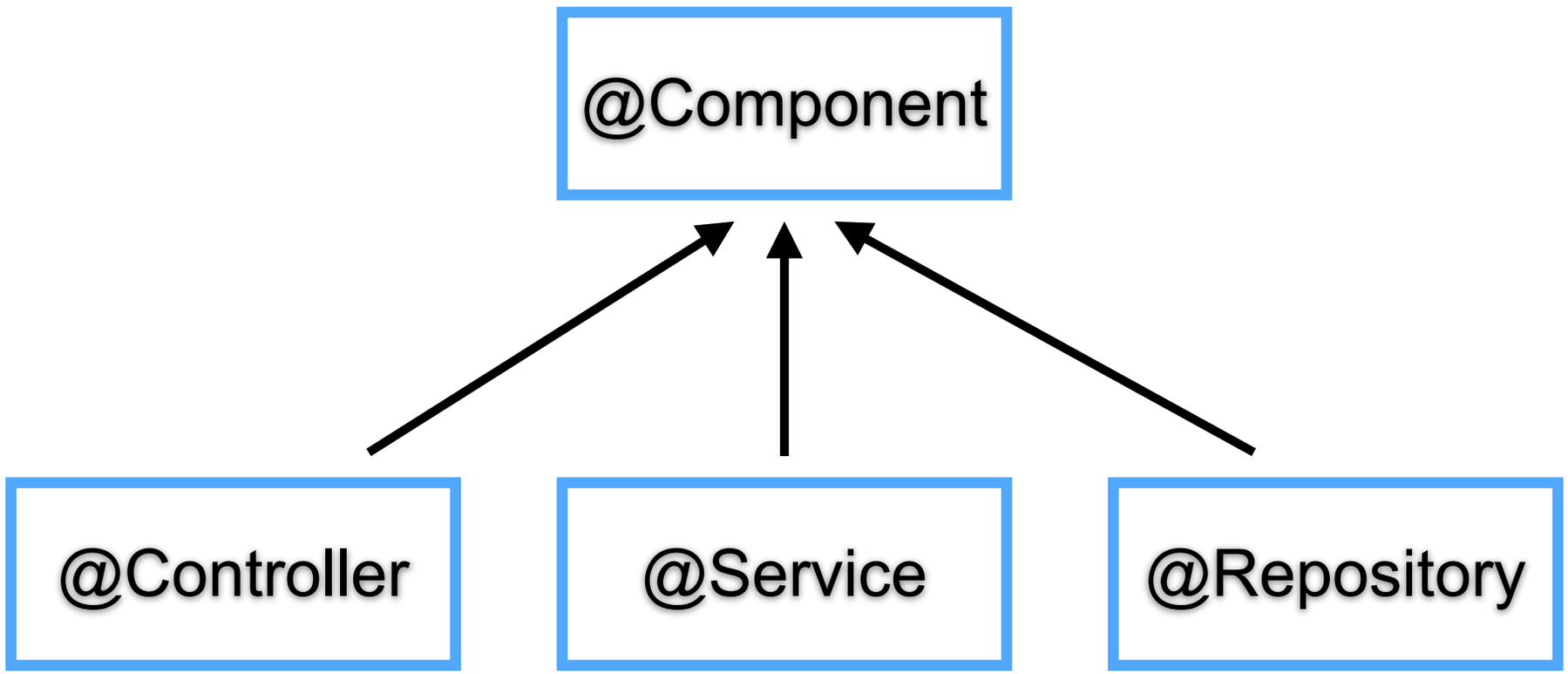
Scope of beans

Singleton
Prototype

What are difference of …

@Component
@Controller
@Service
@Repository

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

Why Spring is popular ?

Enable testable code

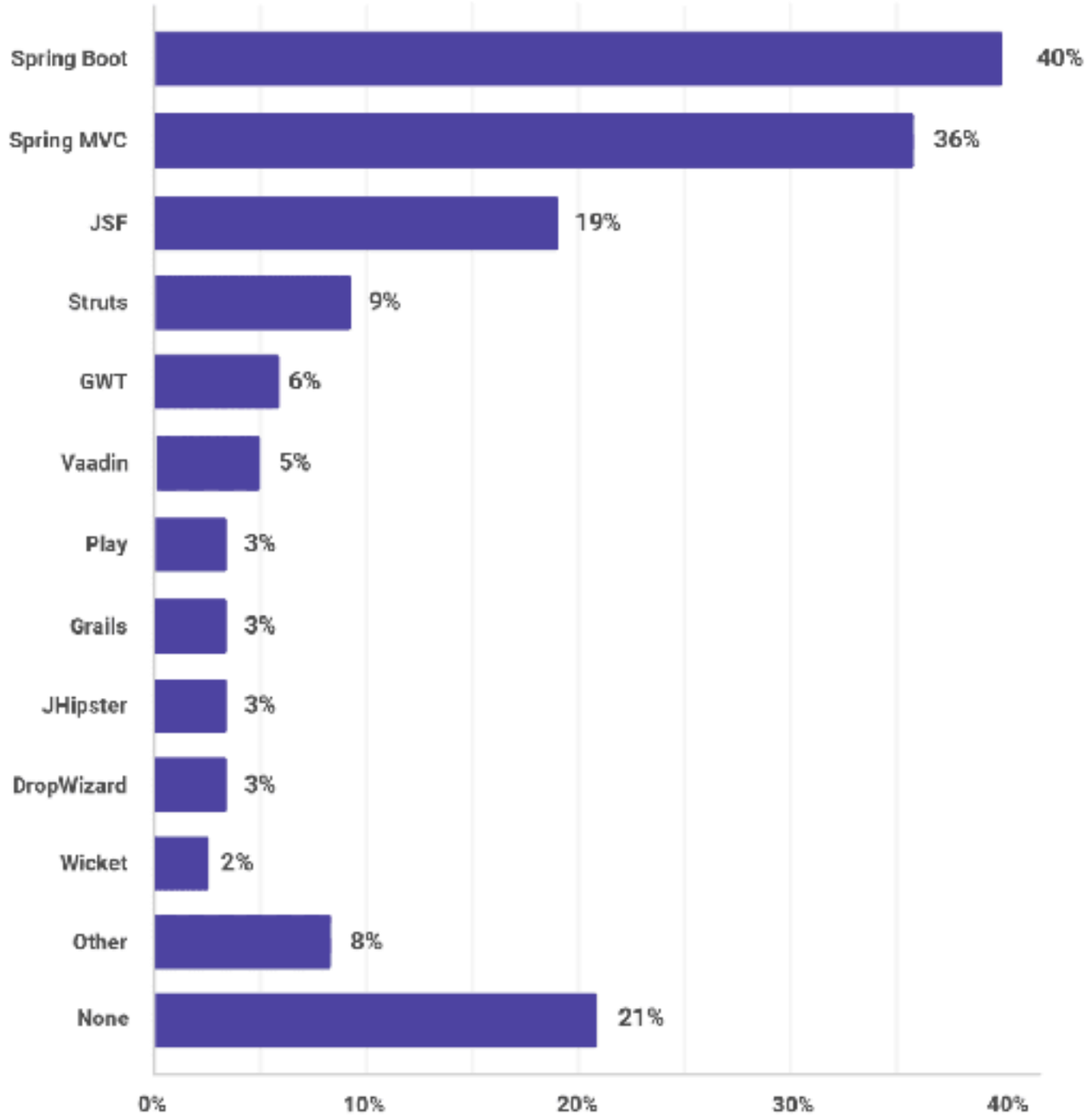
No plumbing code

Flexible architecture

Staying current

Spring Boot

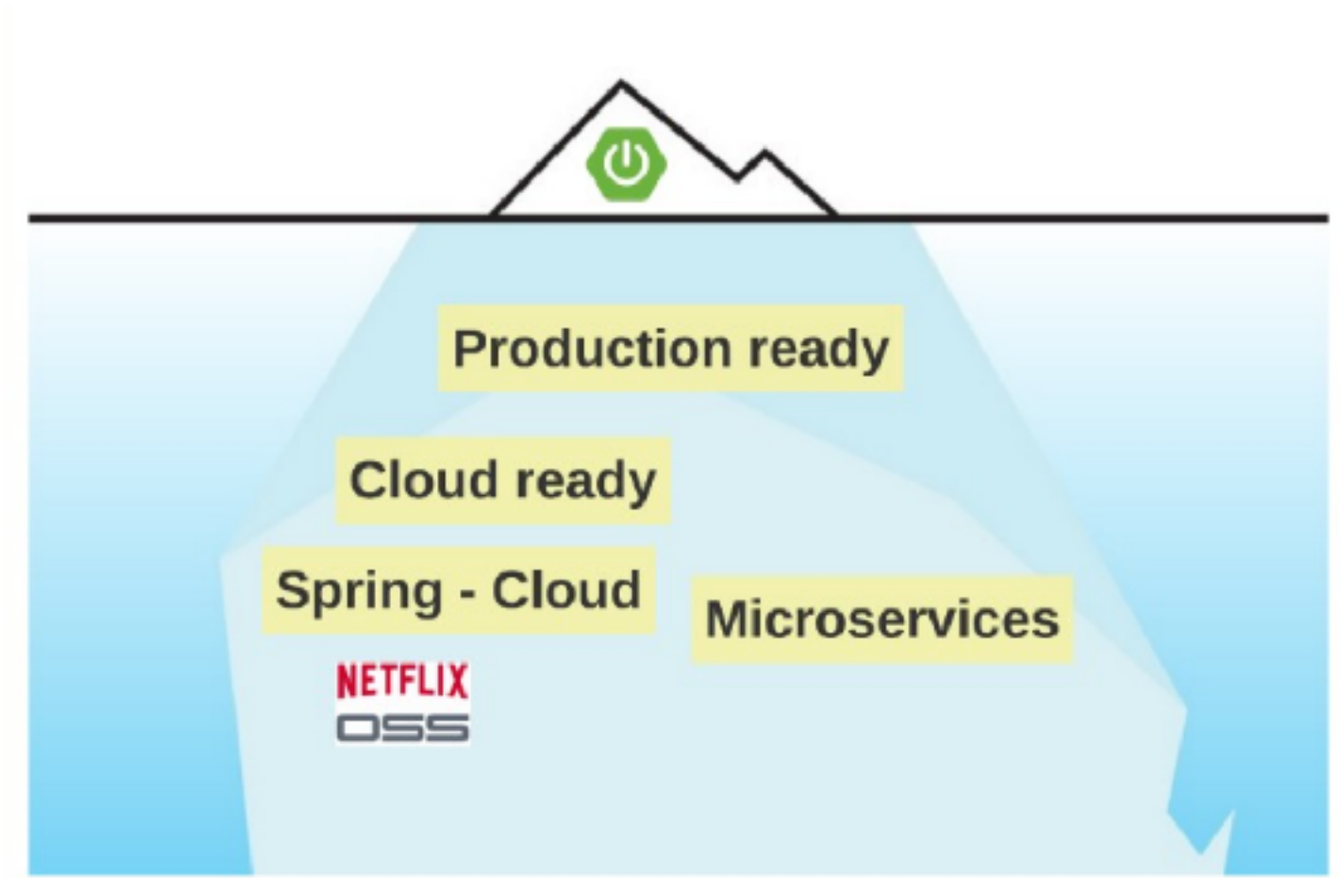
Why ?



https://snyk.io/blog/jvm-ecosystem-report-2018-platform-application/

Why Spring Boot ?

Application skeleton generator for java app
Reduce effort to add new technologies



Spring Framework
vs.
Spring Boot

Spring Framework

Spring Boot

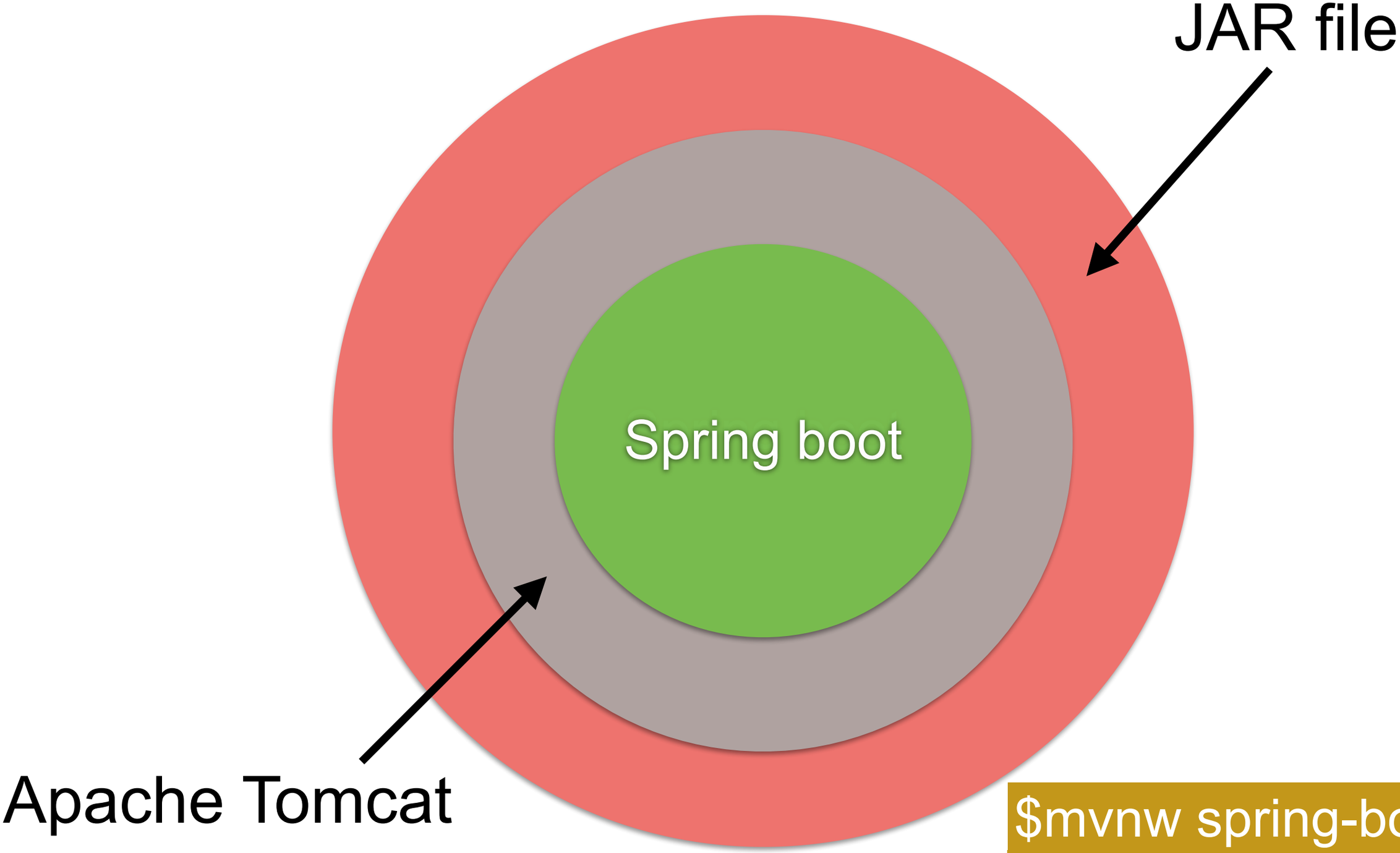
Features

Features ?

Embedded application server
Integration with tools/technologies (starter)
Production tools (monitoring, health check)
Configuration management
Dev tools
No source code generation, no XML

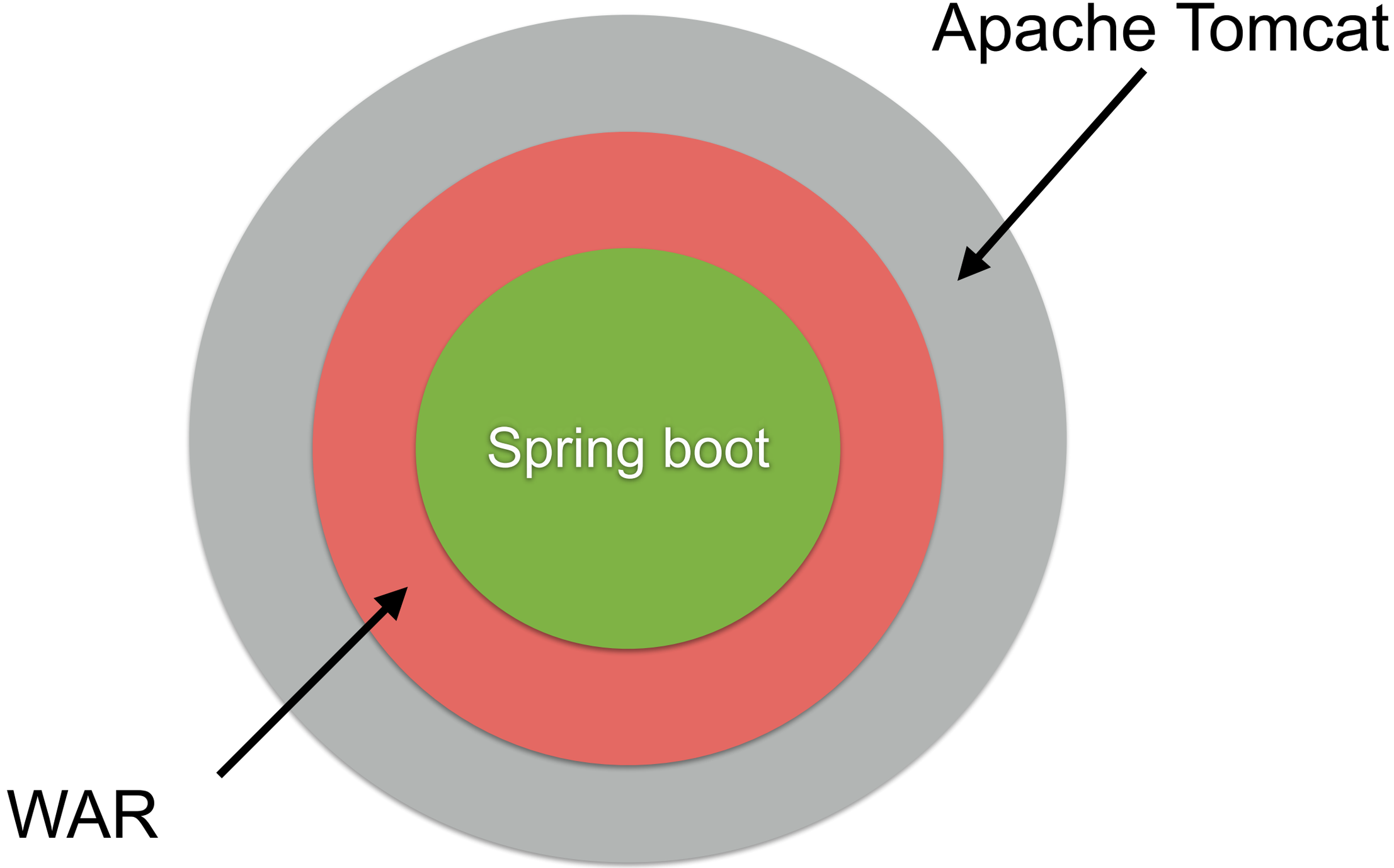
Package and Deploy

How ?




```
$mvnw spring-boot:run
$java -jar demo.jar
```

How ?



Building RESTful API with Spring Boot

REST API

REST Request & Response

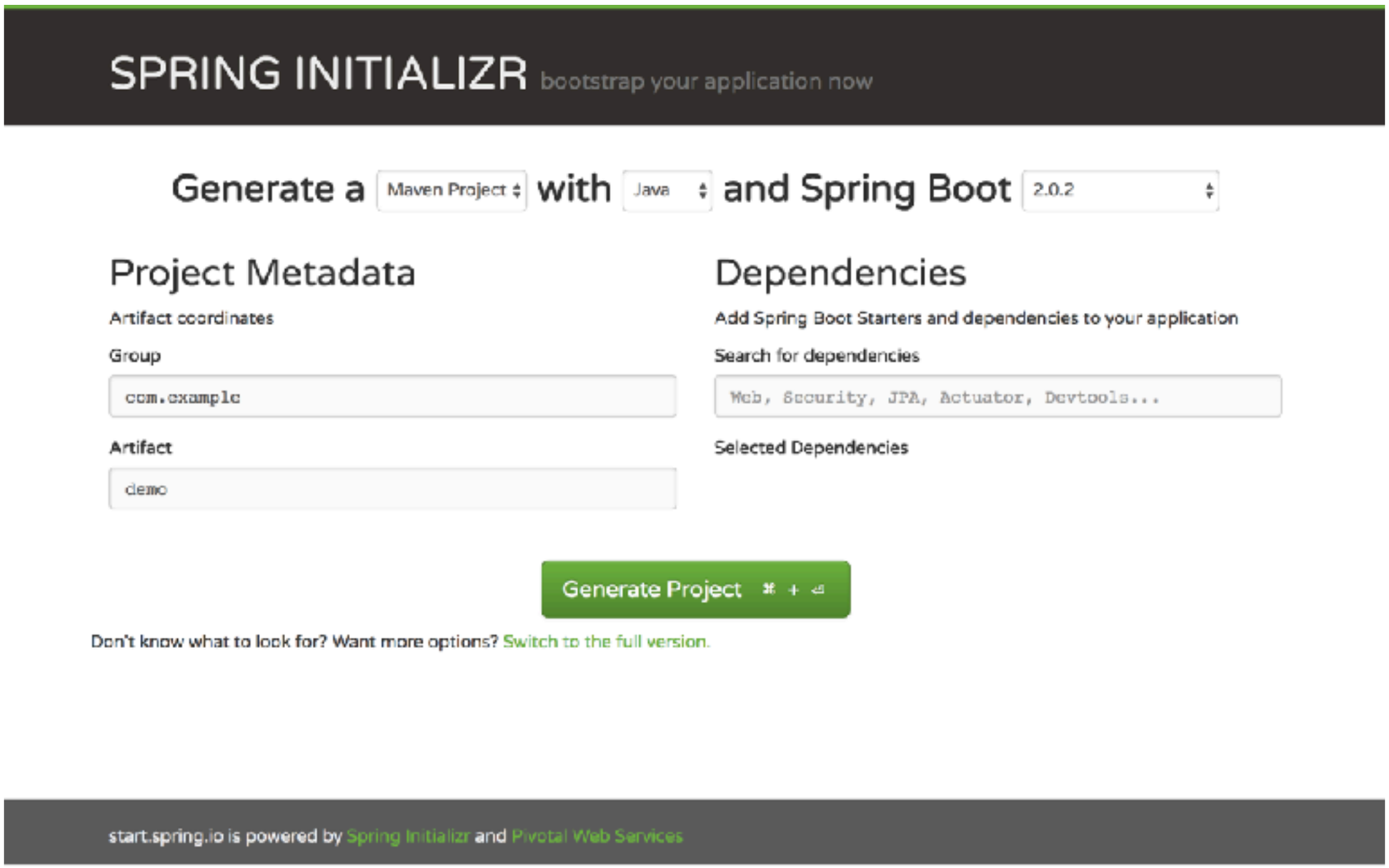
HTTP Methods meaning

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

Create project with Spring Initializr

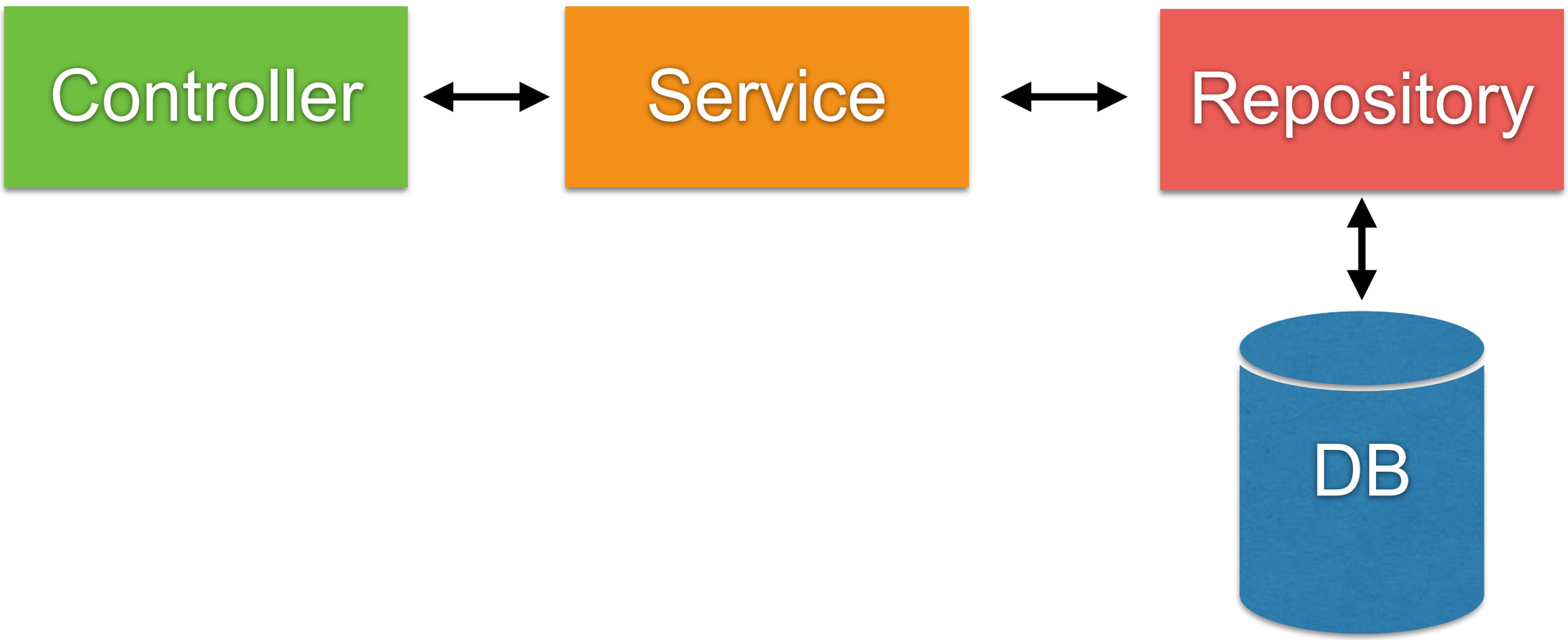
Spring Initializr

https://start.spring.io/



Project 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 logics
Manage database transaction
Don’t reuse service

Repository

Manage data in data store such as RDBMS and NoSQL

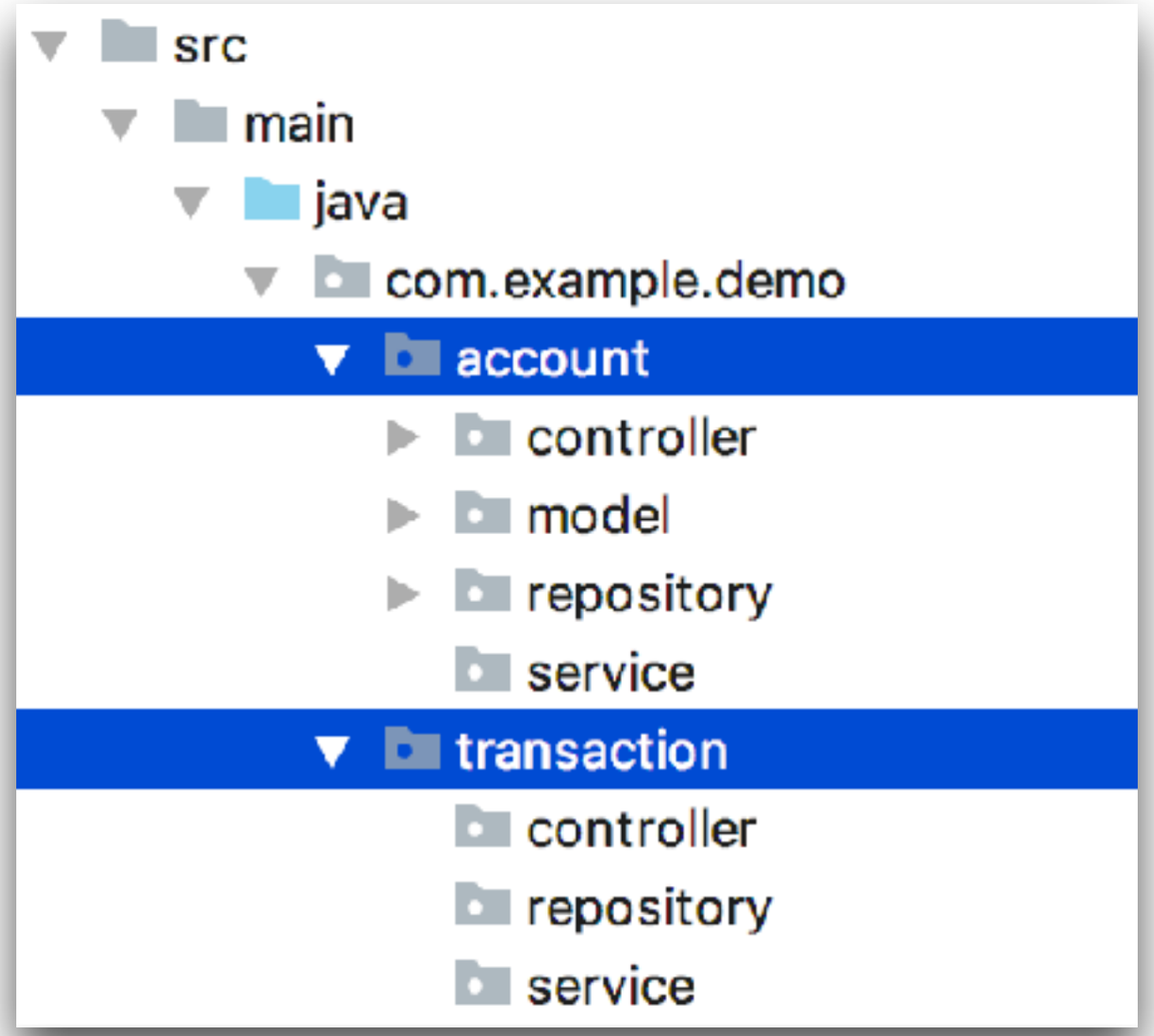
Spring Boot Structure (1)

Separate by function/domain/feature

```
feature1
    - controller
    - service
    - repository
feature2
    - controller
    - service
    - repositor
```

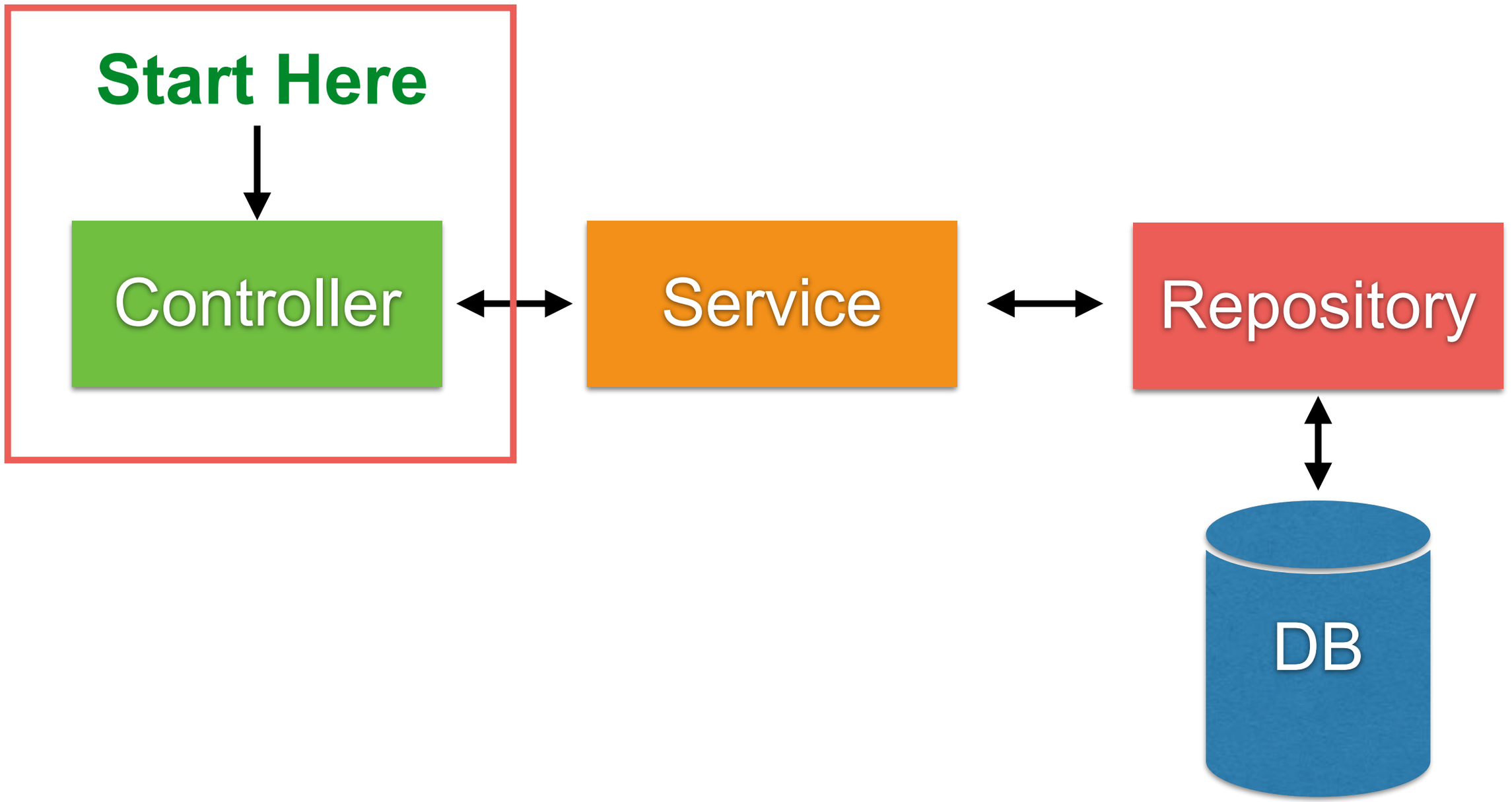
Spring Boot Structure (2)

Separate by function/domain/feature

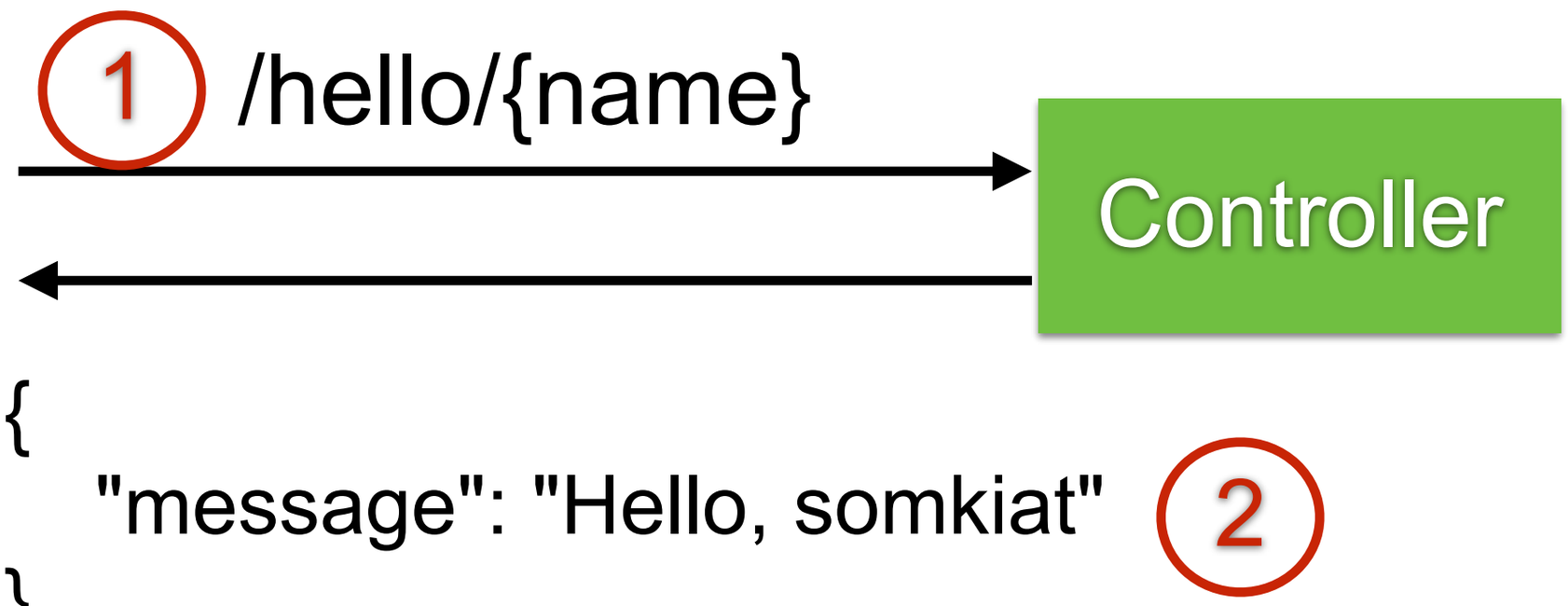


Create first RESTful API

Basic structure of Spring Boot



Hello API



1. Create REST Controller

HelloController.java

```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

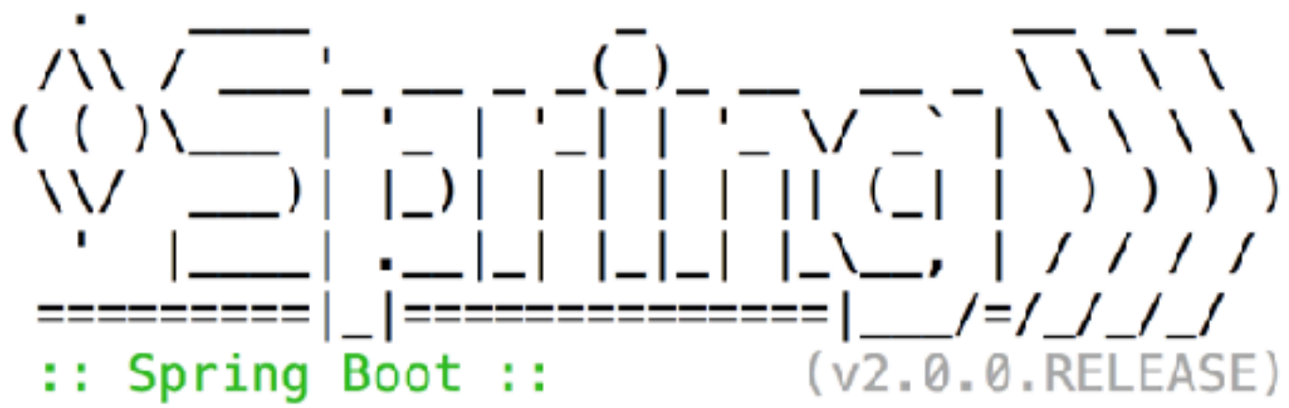
```
public class Hello {

    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



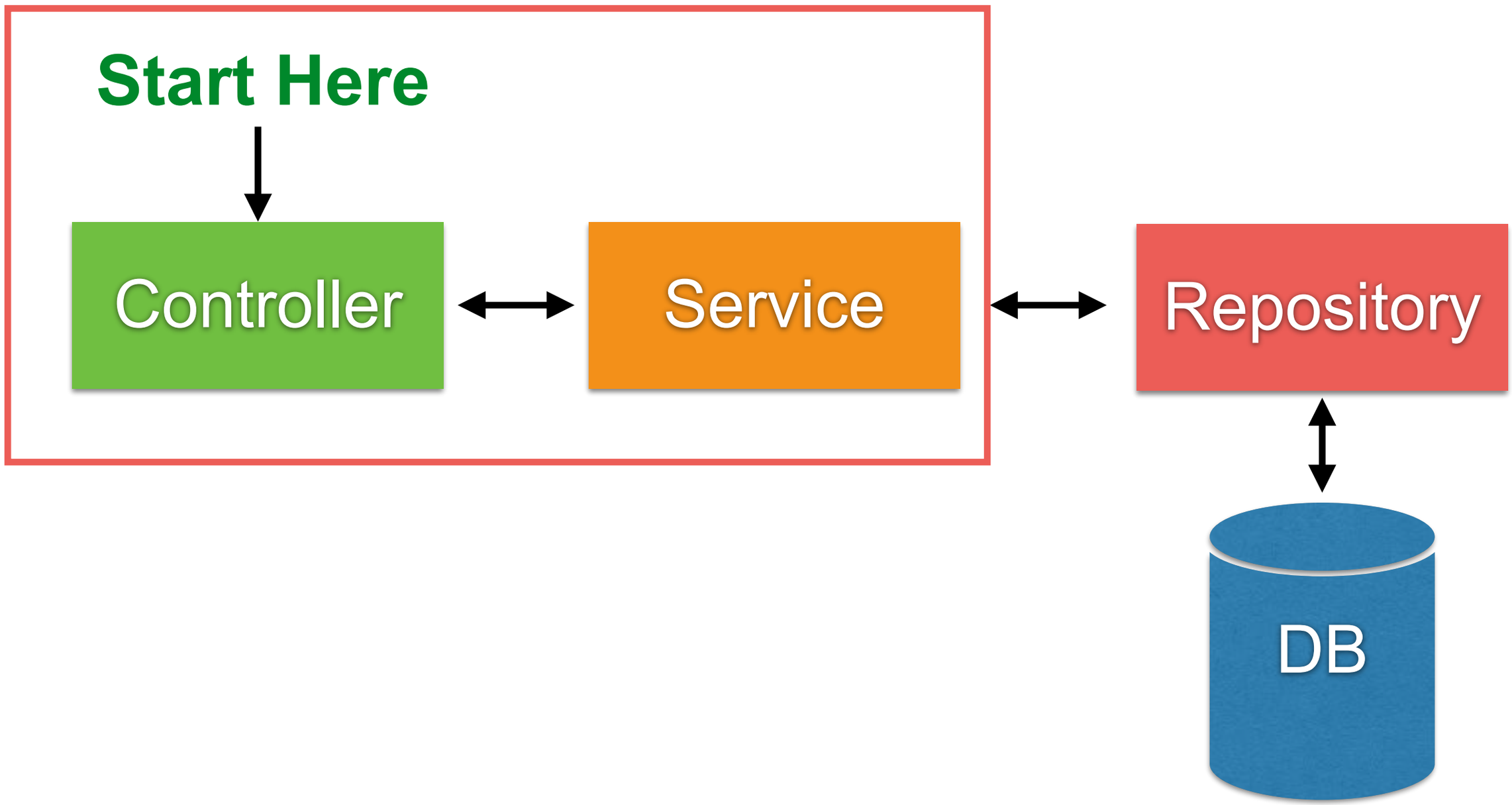

```
2018-03-05 23:37:18.018  INFO 30560 --- [           mair
                    : Starting HelloApplication v1.0-SNAPSH(
th PID 30560 (/Users/somkiat/data/slide/microservice/sl:
op/course-microservice/slide/4days-workshop/workshop/he
 by somkiat in /Users/somkiat/data/slide/microservice/s
hop/course-microservice/slide/4days-workshop/workshop/he
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

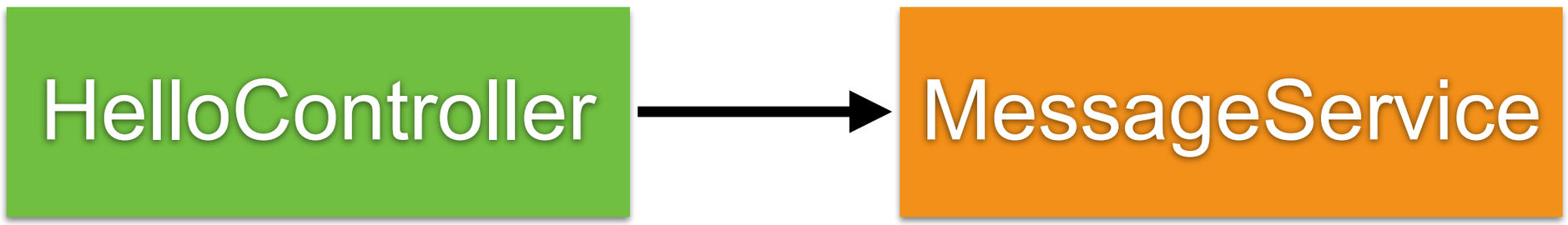
Move business logic to service

Working with service



Move business logic to service

MessageService.java



MessageService.java

```java
@Service
public class MessageService {

    public String concat(String name) {
        return "Hello, " + name;
    }

}
```

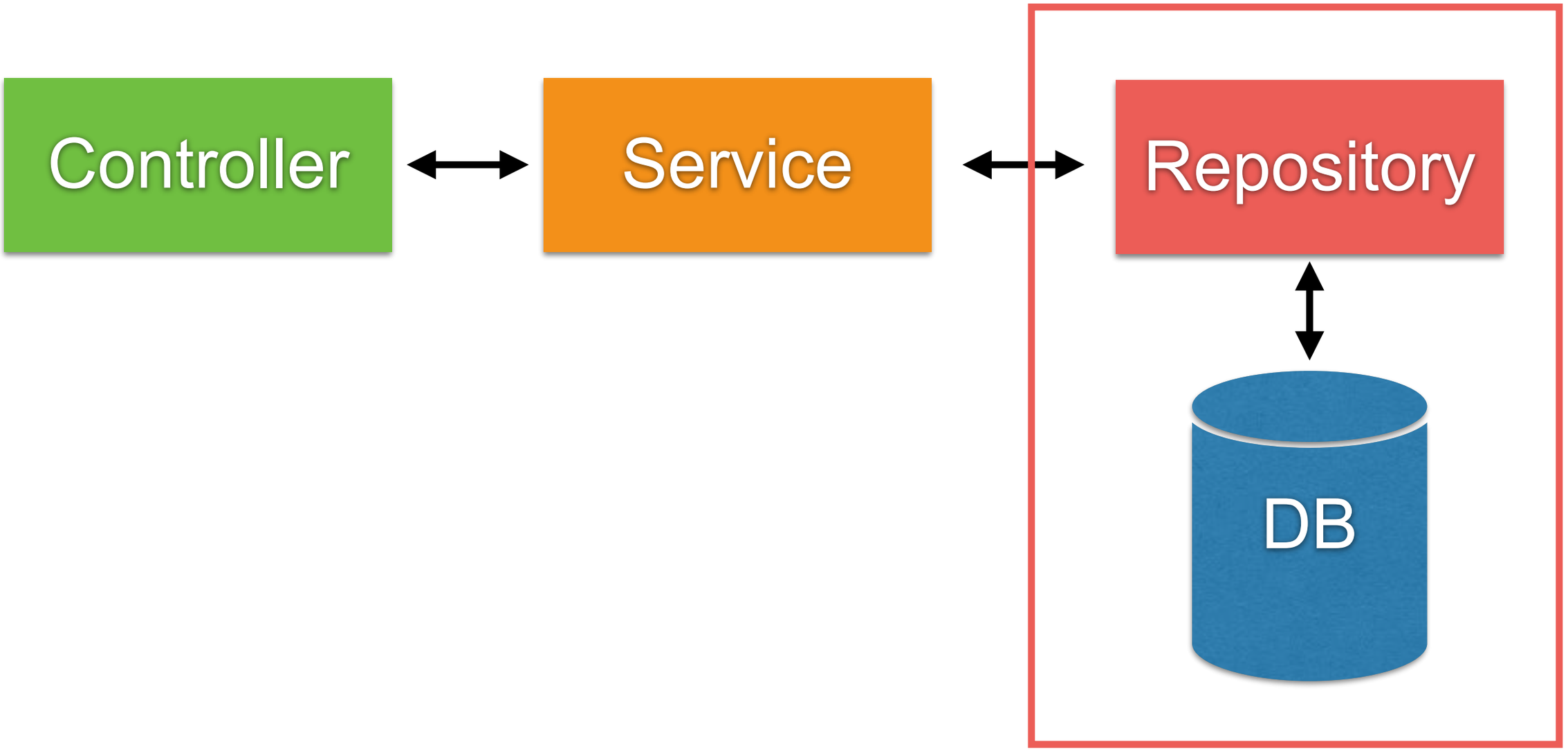
Edit HelloController.java

Call method from service

```
@Autowired
private MessageService messageService;

@GetMapping("/hello/{name}")
public HelloResponse
     sayHi(@PathVariable String name) {
     String result = messageService.concat(name);
     return new HelloResponse(result);
}
```

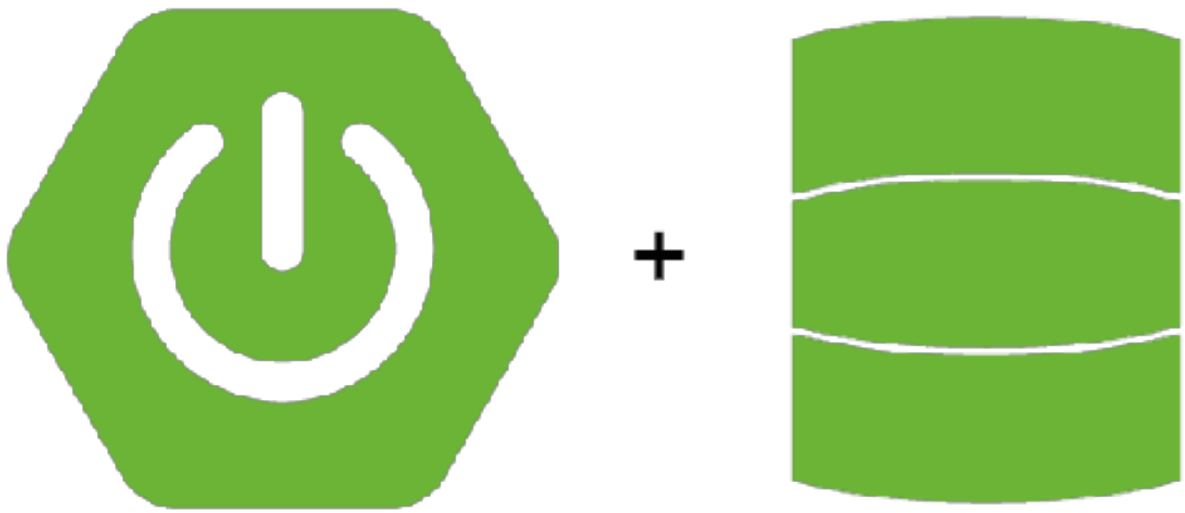
Working with Repository

Working with repository



Working with repository

We’re using Spring Data



http://projects.spring.io/spring-data/

1. Modify pom.xml

Add library of Spring Data such as JPA

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

2. Modify pom.xml (1)

Add library of data store such as **MariaDB**

```
<dependency>
    <groupId>org.mariadb.jdbc</groupId>
    <artifactId>mariadb-java-client</artifactId>
    <version>2.2.6</version>
</dependency>
```

https://mvnrepository.com/artifact/org.mariadb.jdbc/mariadb-java-client

2. Modify pom.xml (2)

Add library of data store such as **PostgreSQL**

```
<dependency>
    <groupId>org.postgresql</groupId>
    <artifactId>postgresql</artifactId>
    <version>42.2.4</version>
</dependency>
```

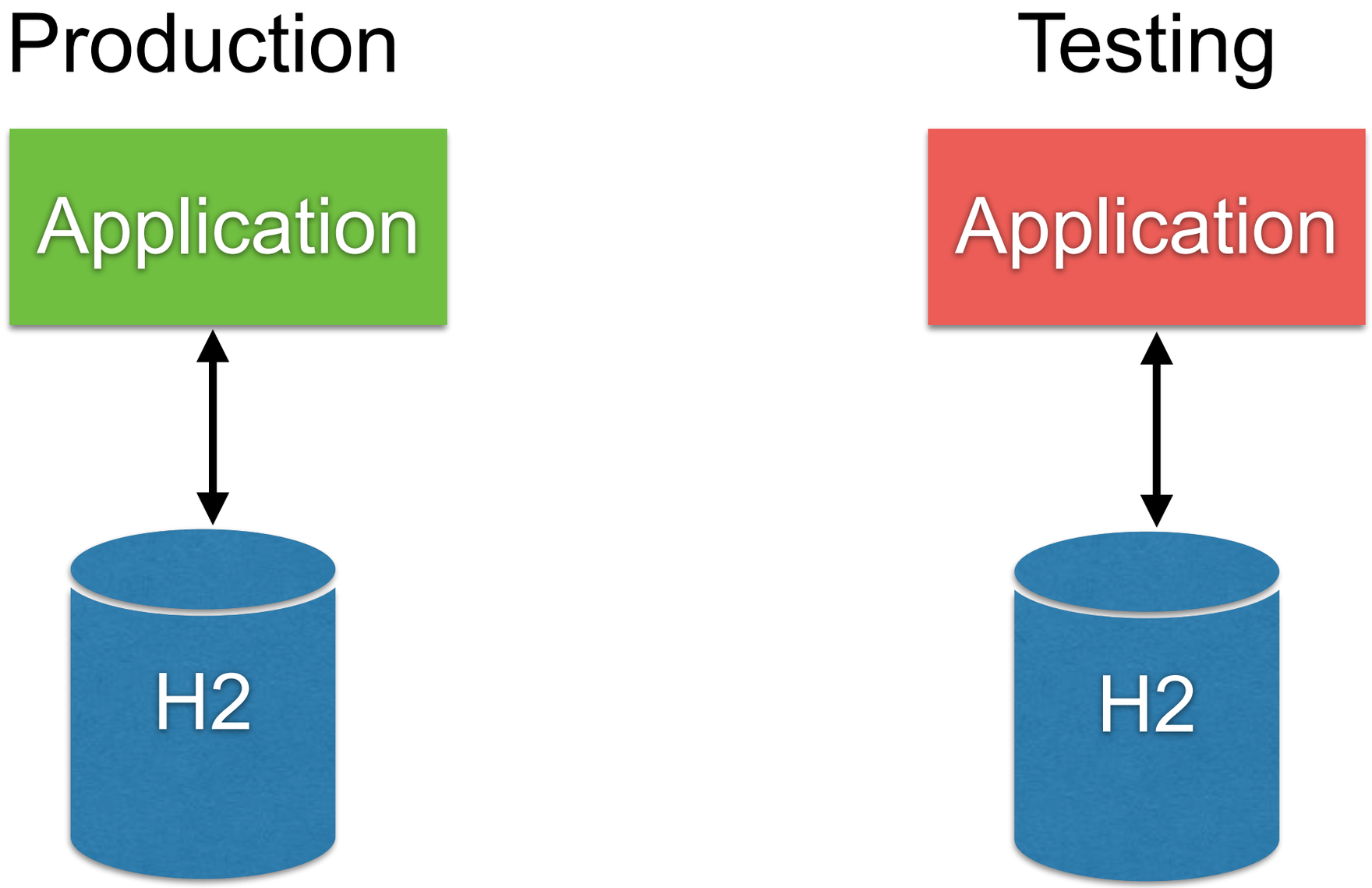
https://mvnrepository.com/artifact/org.postgresql/postgresql

3. Add configuration of database

In src/main/resources/application.properties

spring.jpa.hibernate.ddl-auto=create
spring.datasource.url=<url>
spring.datasource.username=<user>
spring.datasource.password=<password>

Working with H2 Database



Working with H2 database

Add library of data store such as **H2**

```
<dependency>
    <groupId>com.h2database</groupId>
    <artifactId>h2</artifactId>
    <version>1.4.197</version>
</dependency>
```

https://mvnrepository.com/artifact/com.h2database/h2/

Create repository with JPA

MessageRepository.java

```
public interface MessageRepository
        extends CrudRepository<Message, Integer> {

}
```

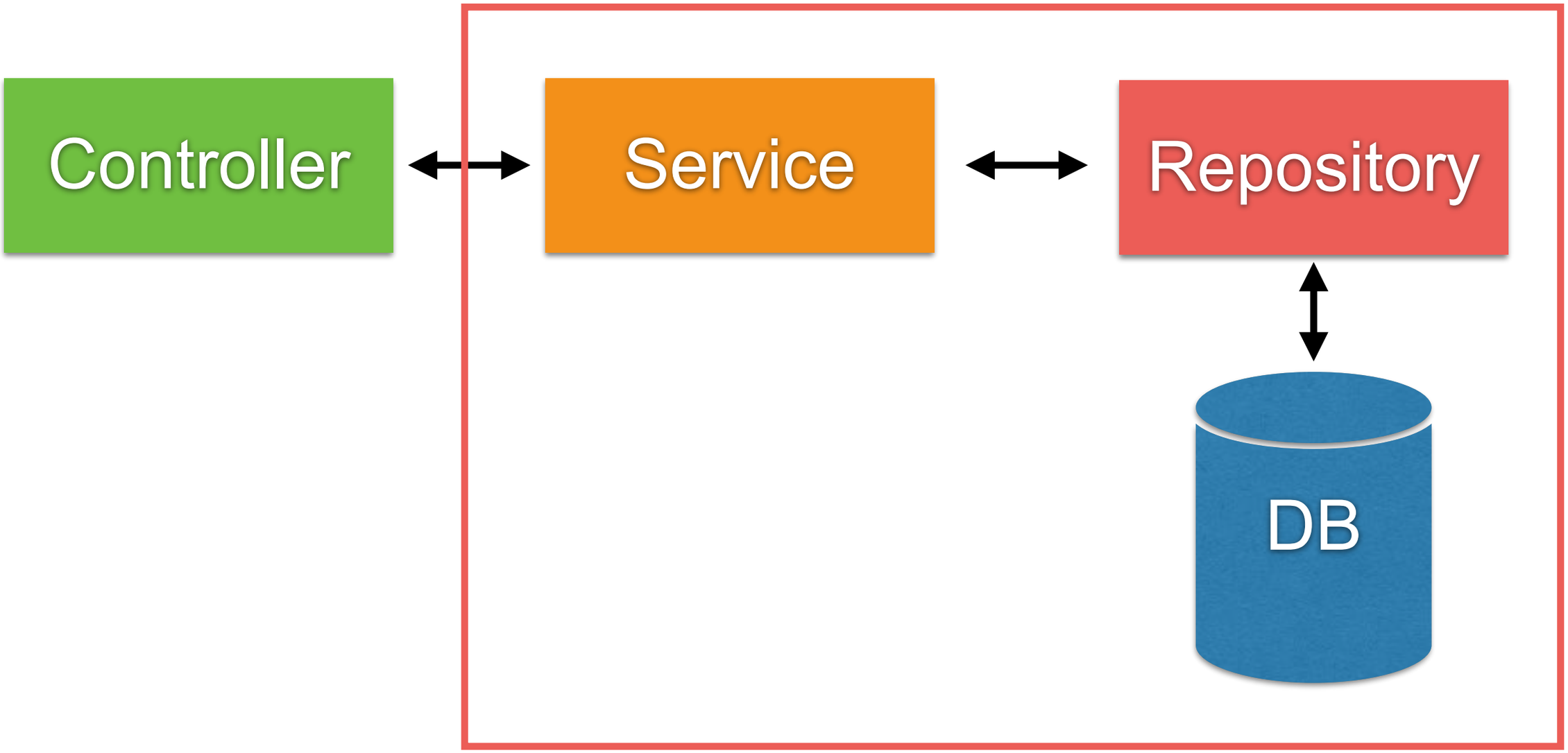
Create Entity class

Message.java

```
@Entity
public class Message {

    @Id
    @GeneratedValue(strategy = GenerationType.AUTO)
    private int id;
    private String data;
```

Integrate repository with service

Service use repository ?



Service call repository

Edit MessageService.java

```
@Service
public class MessageService {

    @Autowired
    private MessageRepository messageRepository;

    public String concat(String name) {
        Optional<Message> result = messageRepository.findById(1);
        if(result.isPresent()) {
            return "Hello, " + name;
        } else {
            return "Not found";
        }
    }

}
```

Run spring boot

$mvnw spring-boot:run

Service call repository

```java
@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));
    }
```

1

Service call repository

```java
@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));
    }
```

2

Initial data in database

Initial database #1

Using @Bean and CommandLineRunner

```
@Bean
public CommandLineRunner initialData(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/somkia
.datasource.init.ScriptUtils     : Executing SQL script from URL [file:/Users/somki
.datasource.init.ScriptUtils     : Executed SQL script from URL [file:/Users/somkia
```

Run spring boot

$mvnw spring-boot:run

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);

    }

}
```

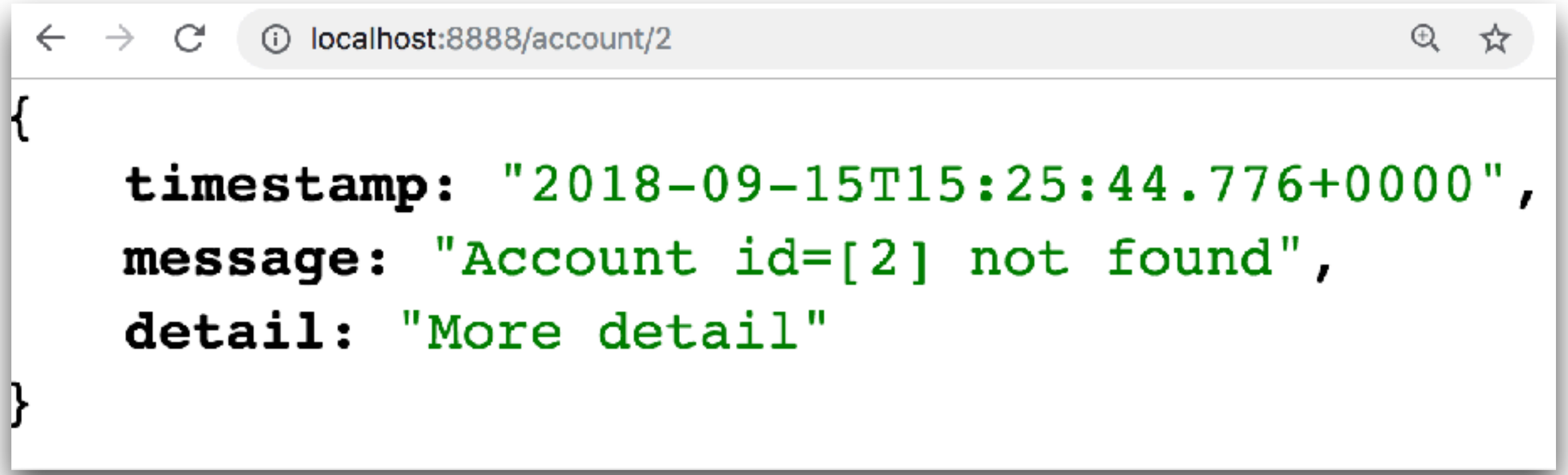
2

ExceptionReponse

Response format of error

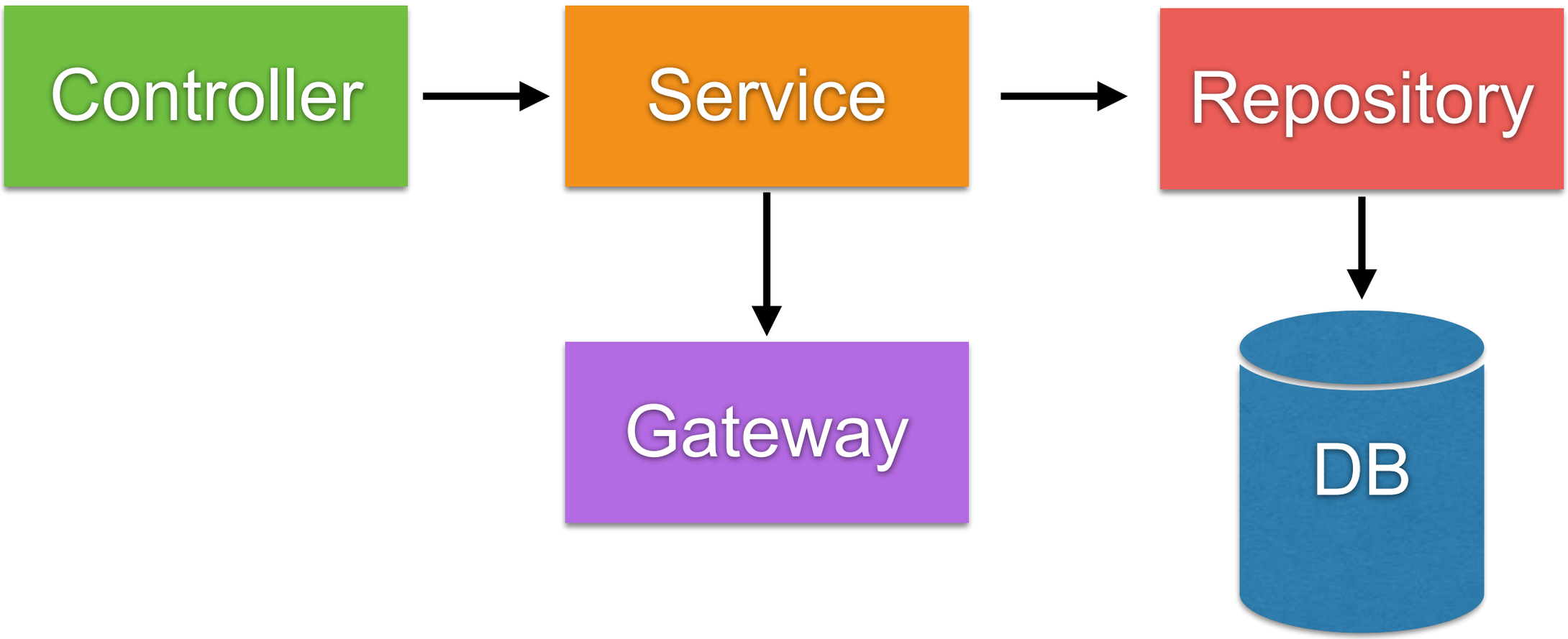
```
public class ExceptionResponse{

    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



Call External APIs

Call External API



Call external APIs

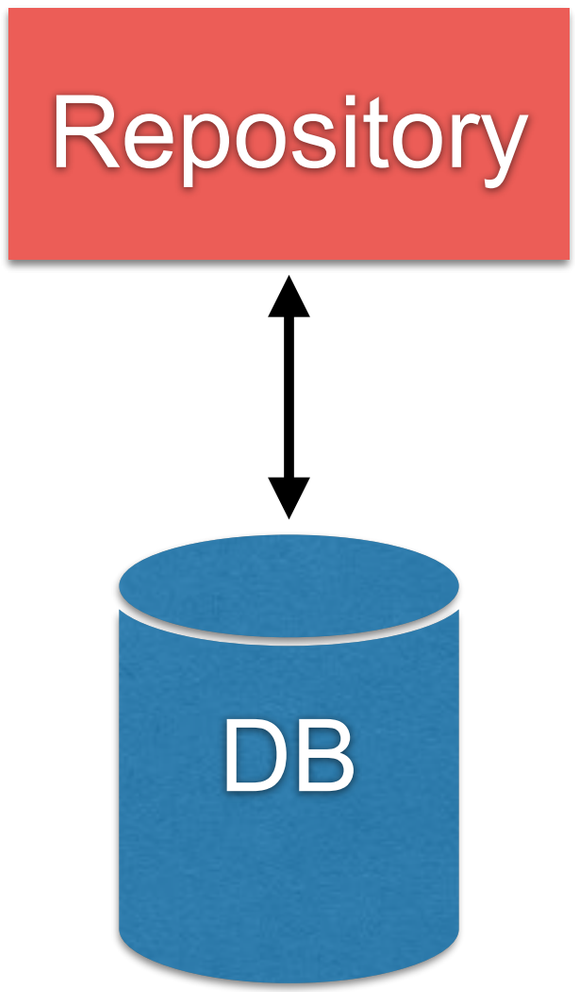
REST template
Spring Cloud OpenFeign
WebClient for reactive

Manage transaction

Transaction Propagation

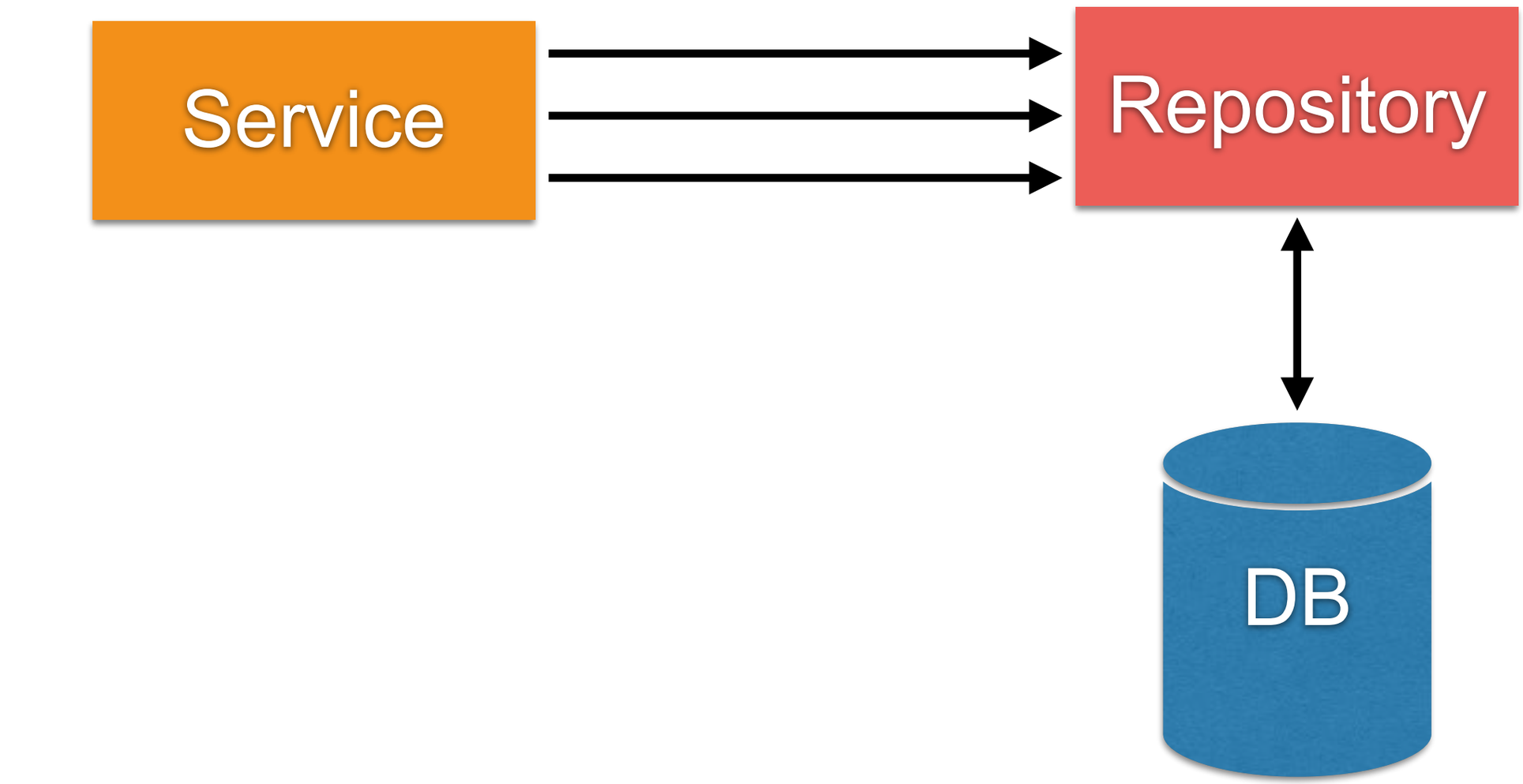
Declarative
Programmatic

Enable TransactionManager



Control transaction

@Transactional



Transaction Propagation

Propagation define our business transaction boundary, start and pause transaction in Spring

REQUIRED
SUPPORTS
MANDATORY
NEVER
NOT_SUPPORTED
REQUIRES_NEW

Transaction Isolation

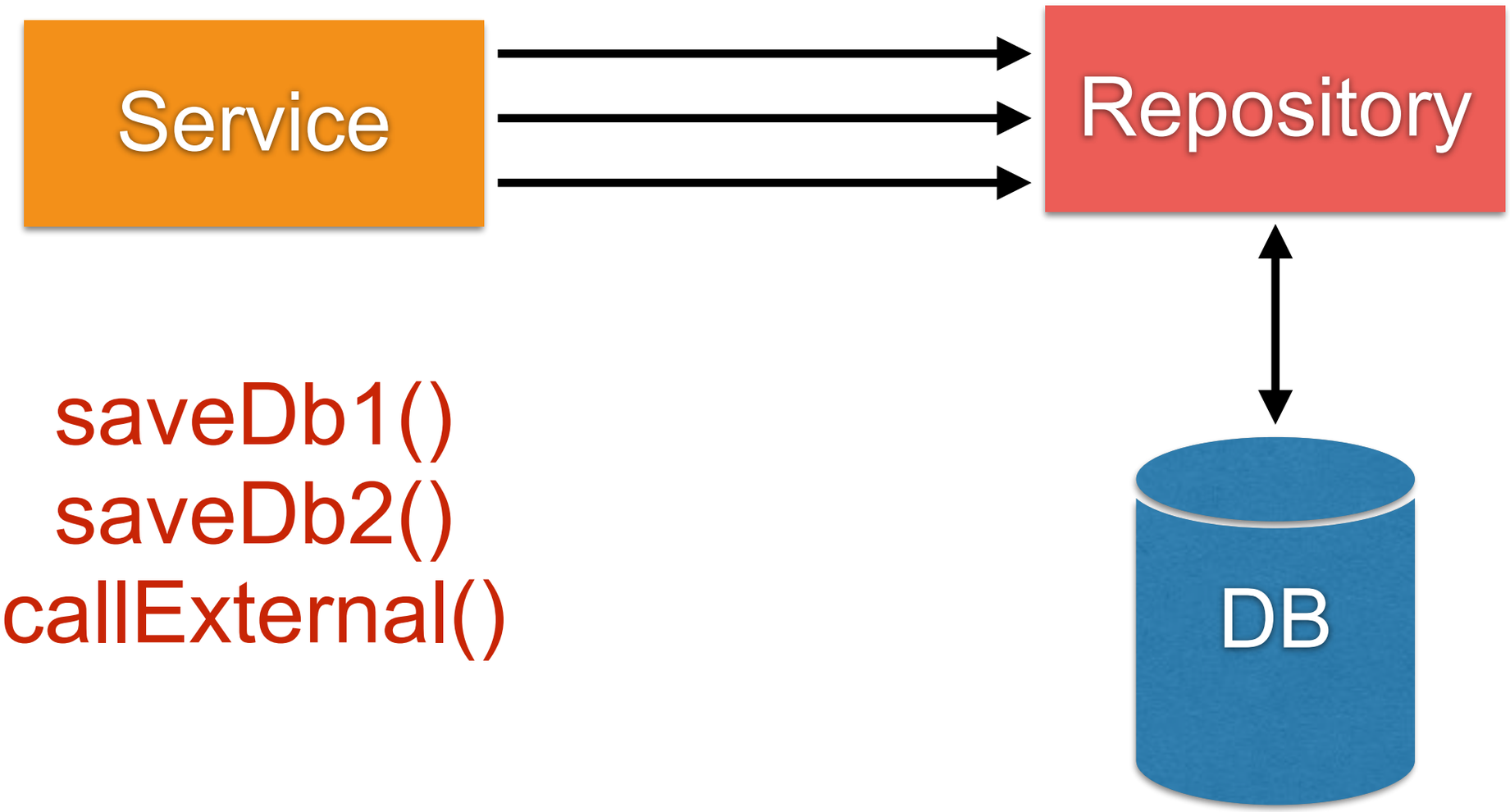
Isolation describe how changes applied by concurrent transactions are visible to each other

Dirty read
Non-repeatable read
Phantom read

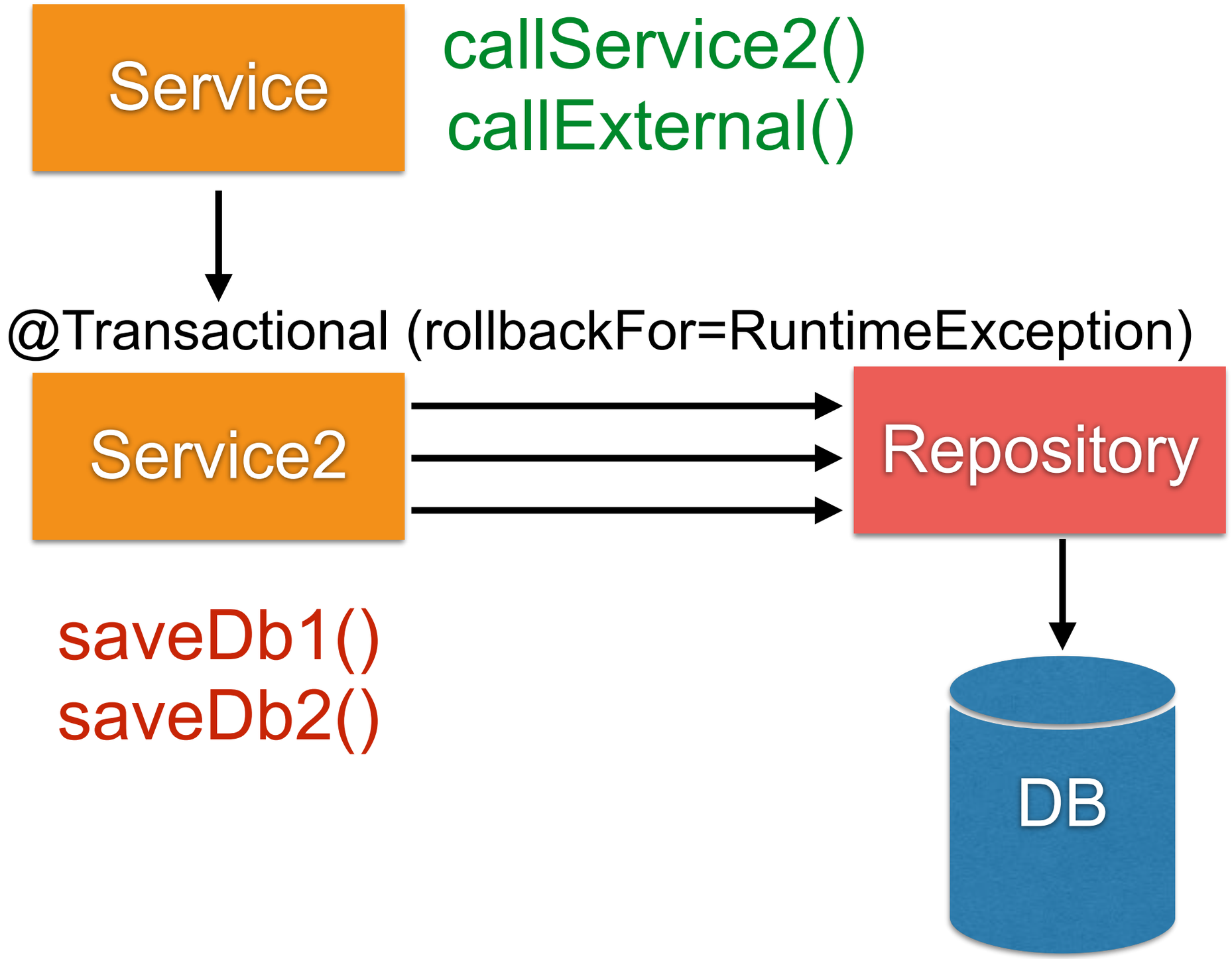
Pitfall

@Transactional

saveDb1()
saveDb2()
callExternal()



Pitfall


Service
callService2()
callExternal()
@Transactional (rollbackFor=RuntimeException)
Service2
Repository
saveDb1()
saveDb2()
DB

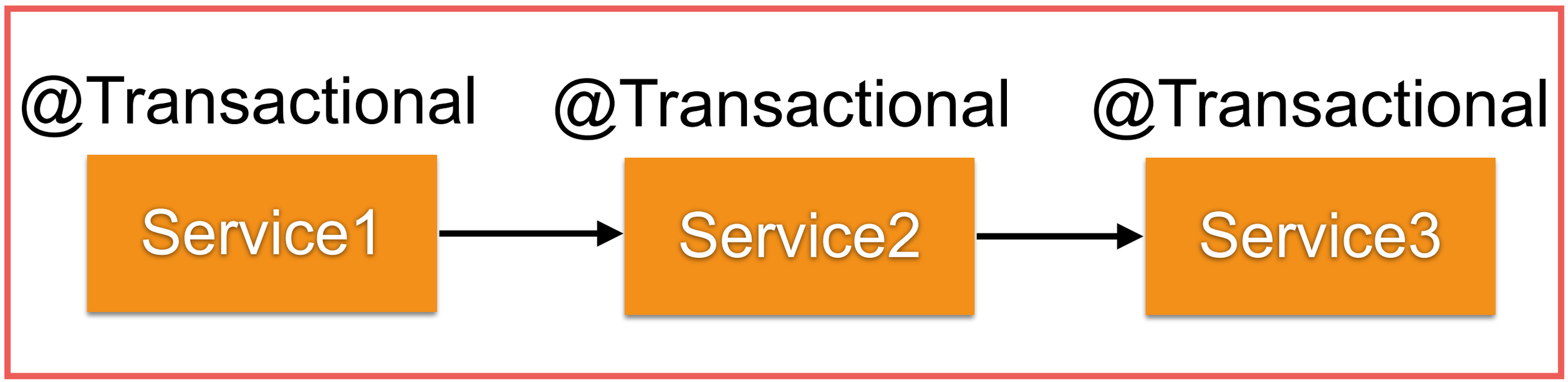
Default = Rollback with Unchecked/Runtime exception

@Transactional

Rollback with Checked exception

@Transactional (rollbackFor=RuntimeException)

Transaction propagation !!



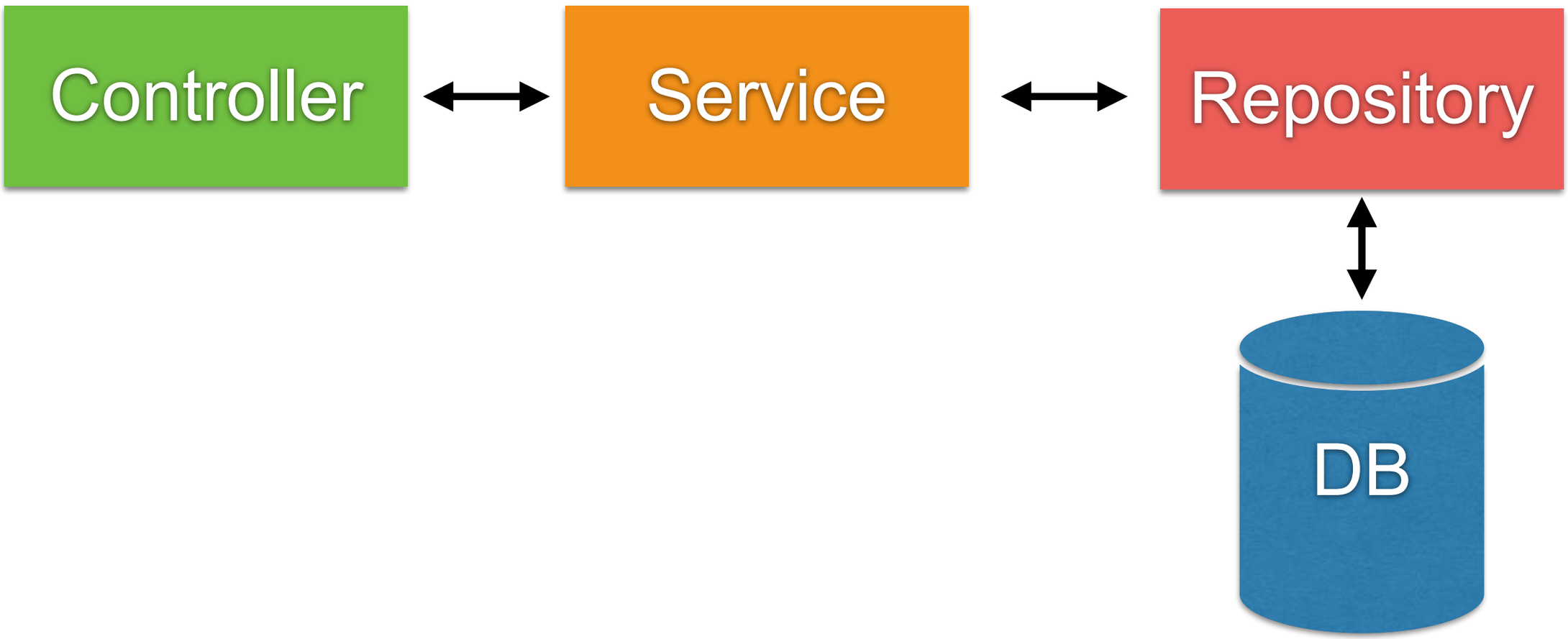
By default :: Use transaction of service 1

Propagation = REQUIRES

Testing

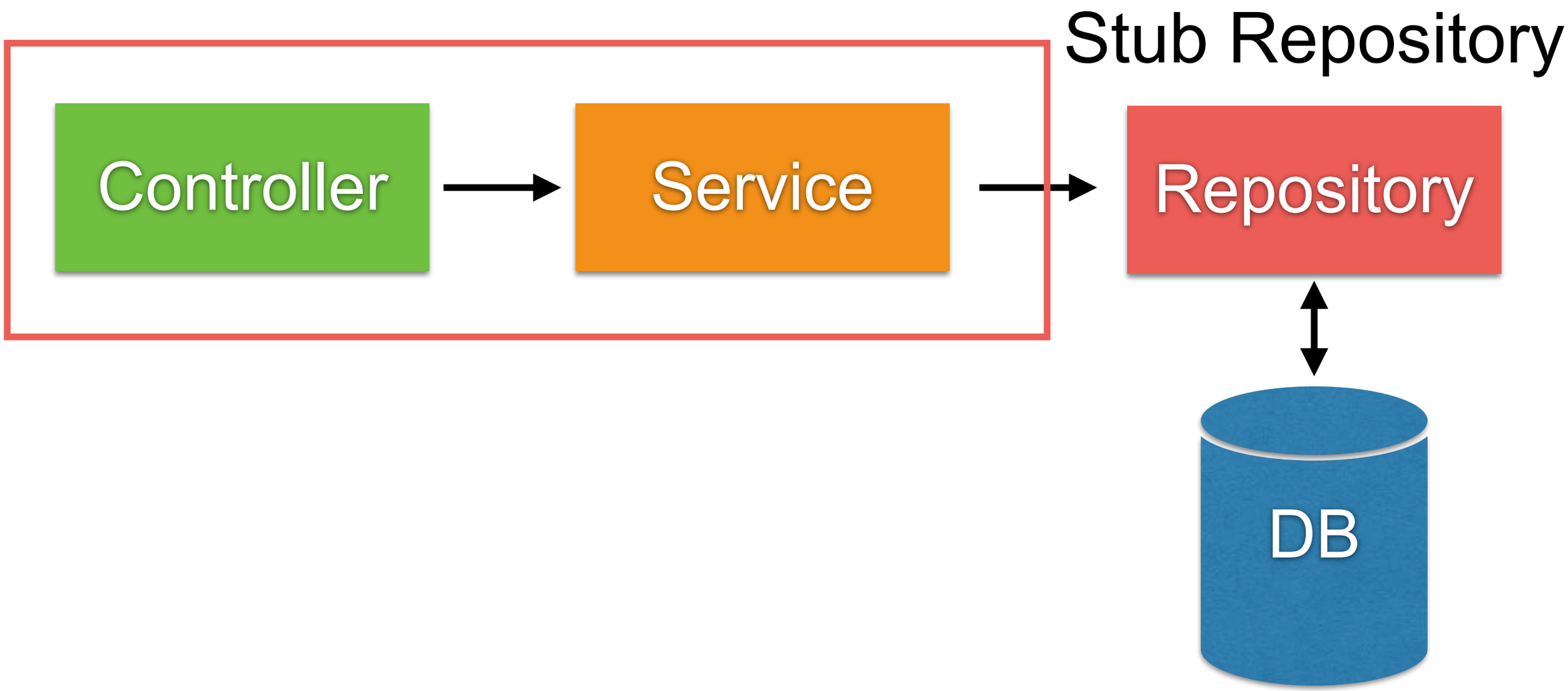
Controller Testing with SpringBootTest

How to test ?

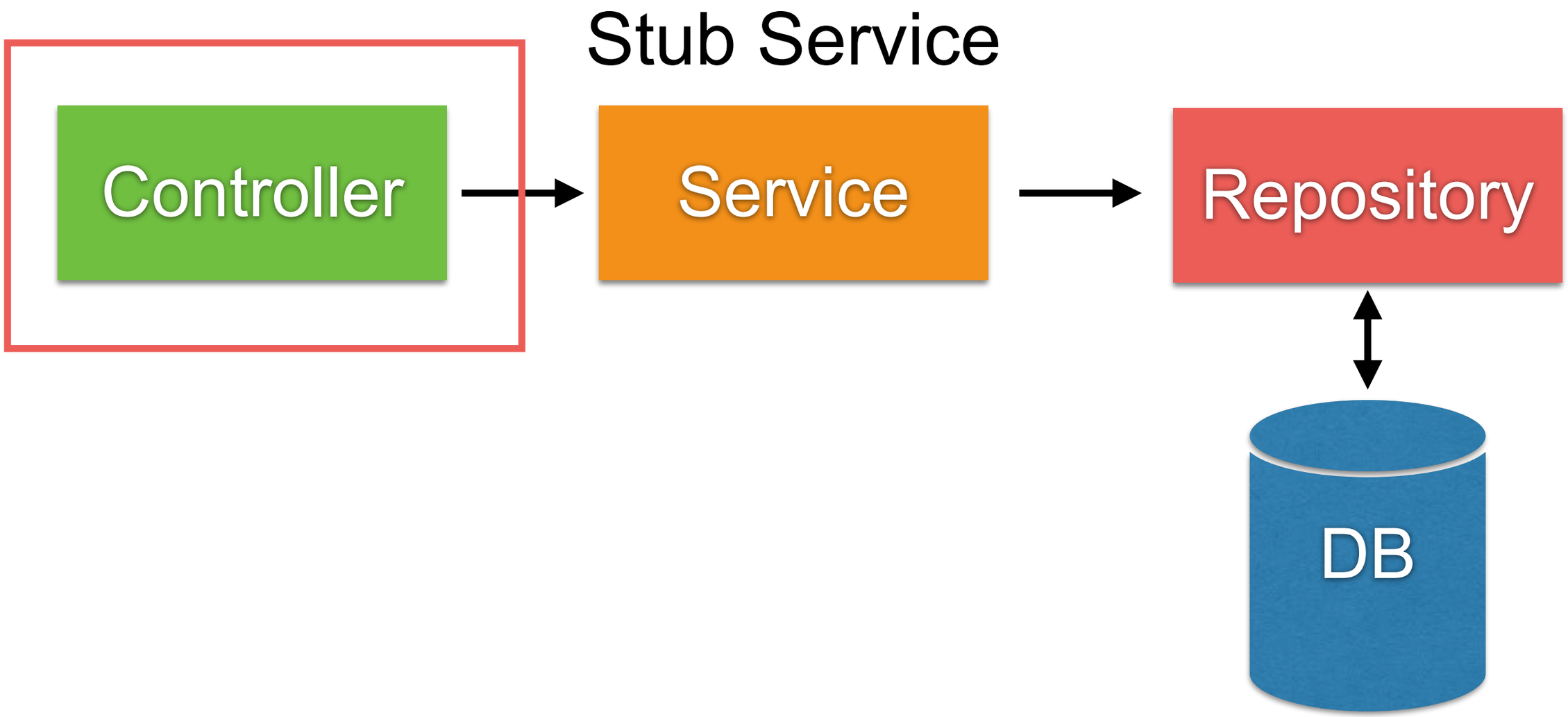


Controller Testing + Stub

How to test ?

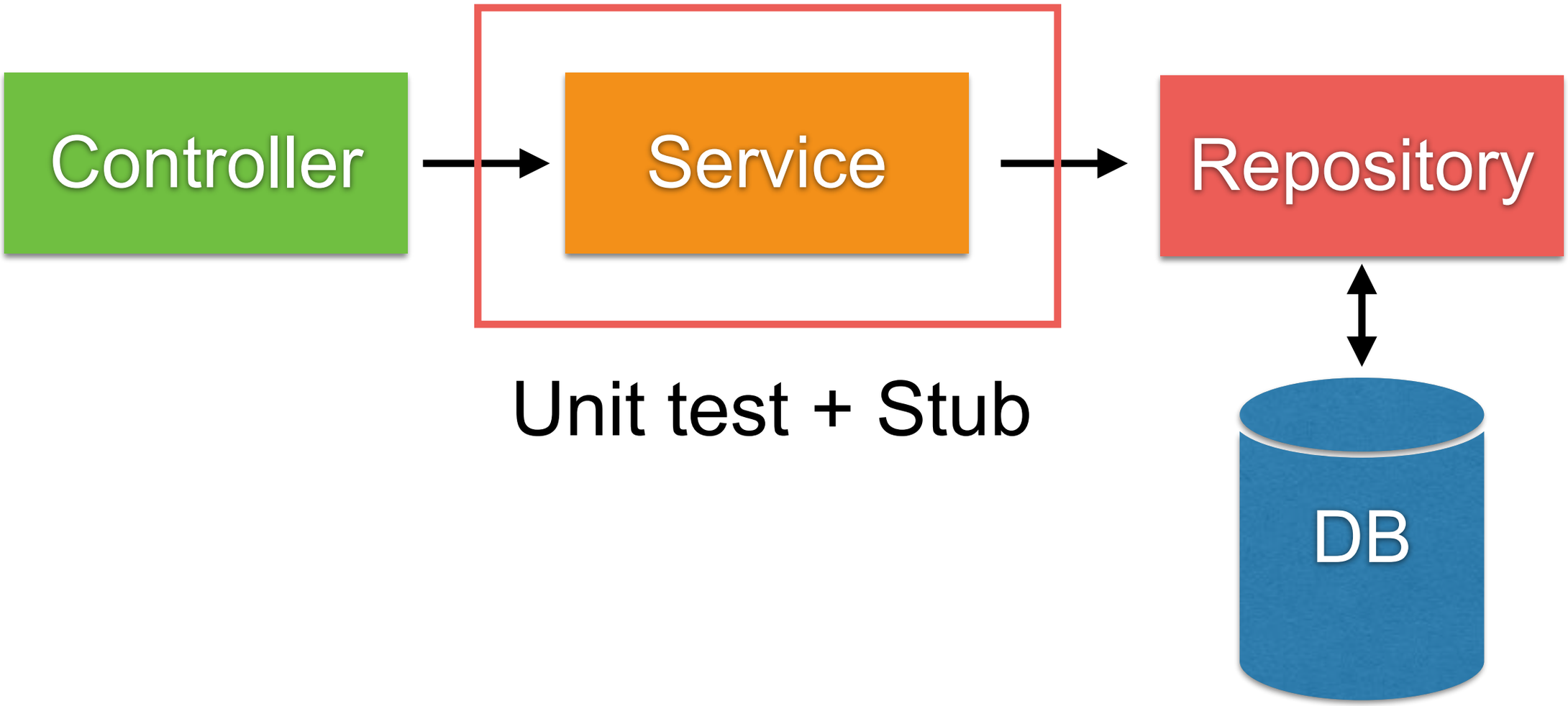


How to test ?



Unit testing for business logic

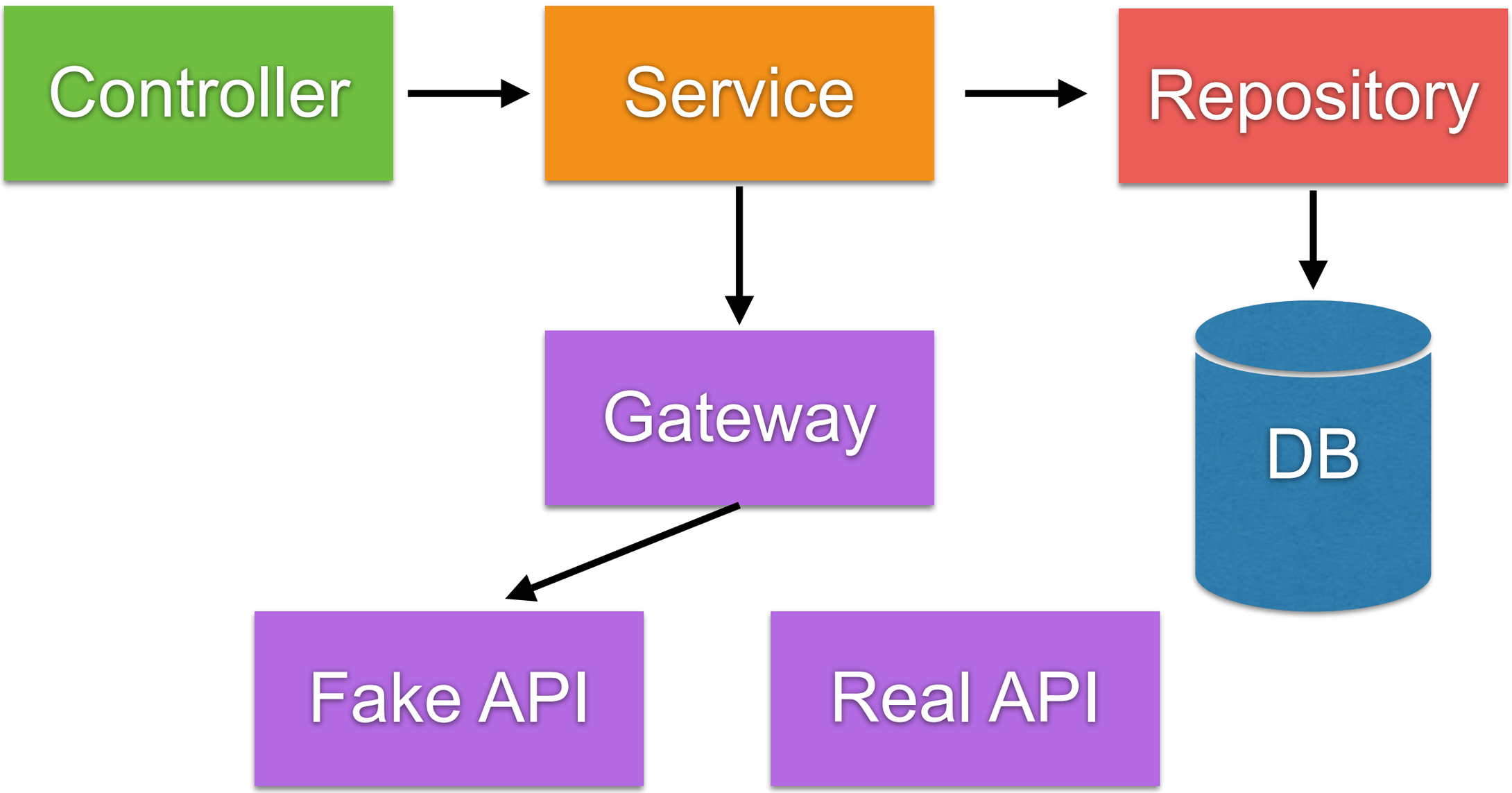
How to test ?



Unit test + Stub

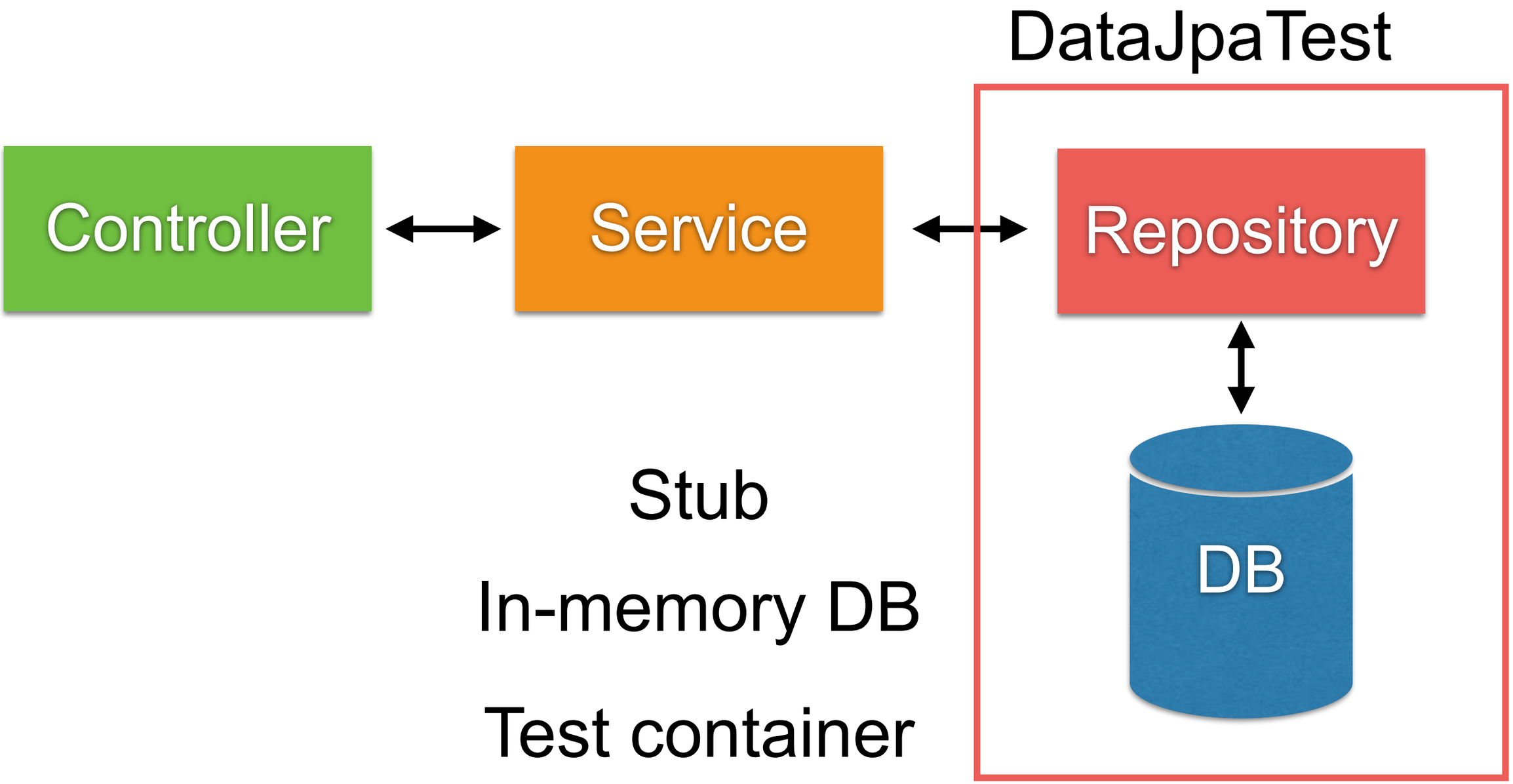
Component testing
With External API

Testing External API



Repository testing

How to test ?



Stub

In-memory DB

Test container

Call External API