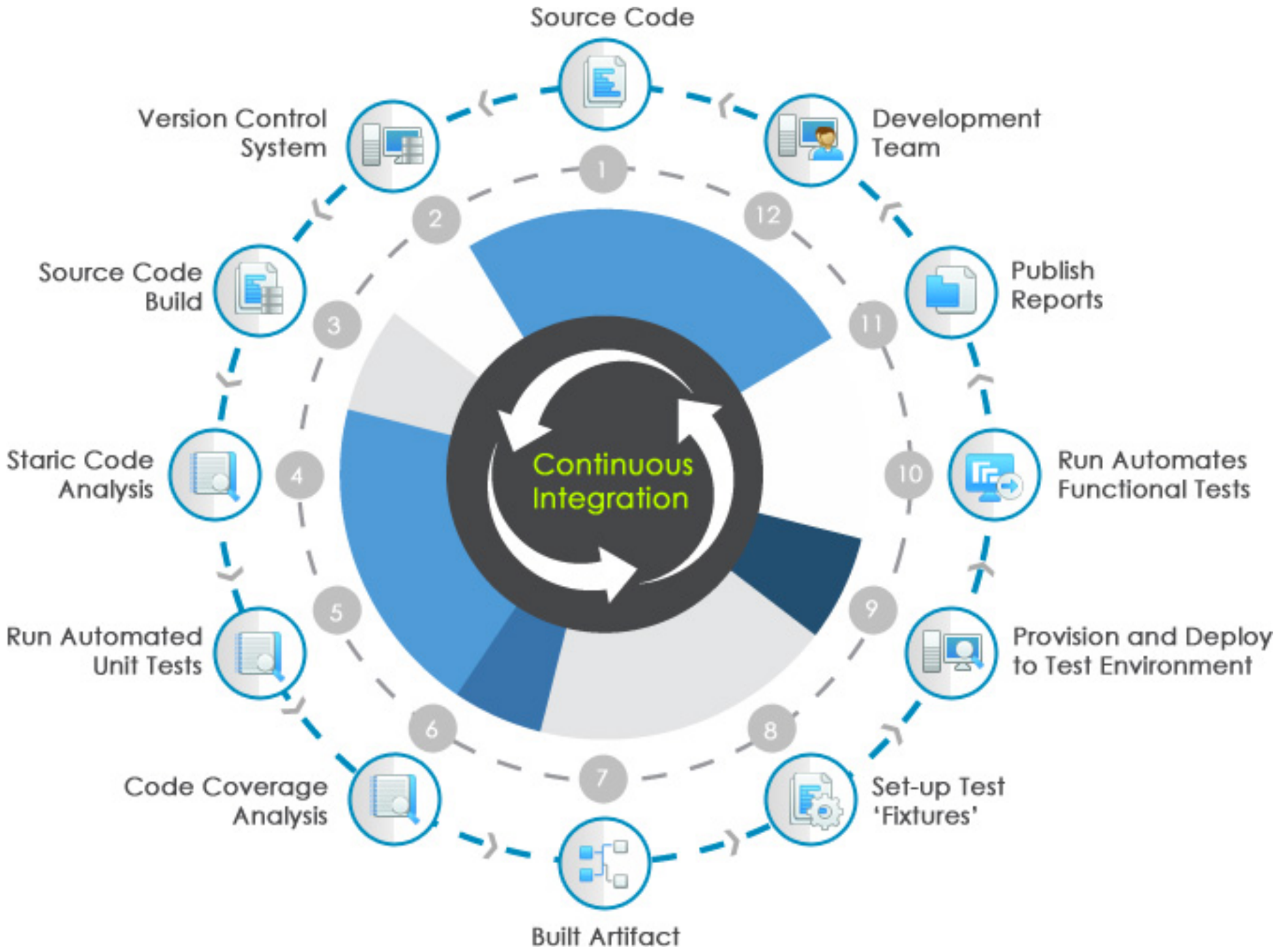
สยามชำนาญกิจ
SIAM CHAMNAN KIT

Microservices and DevOps

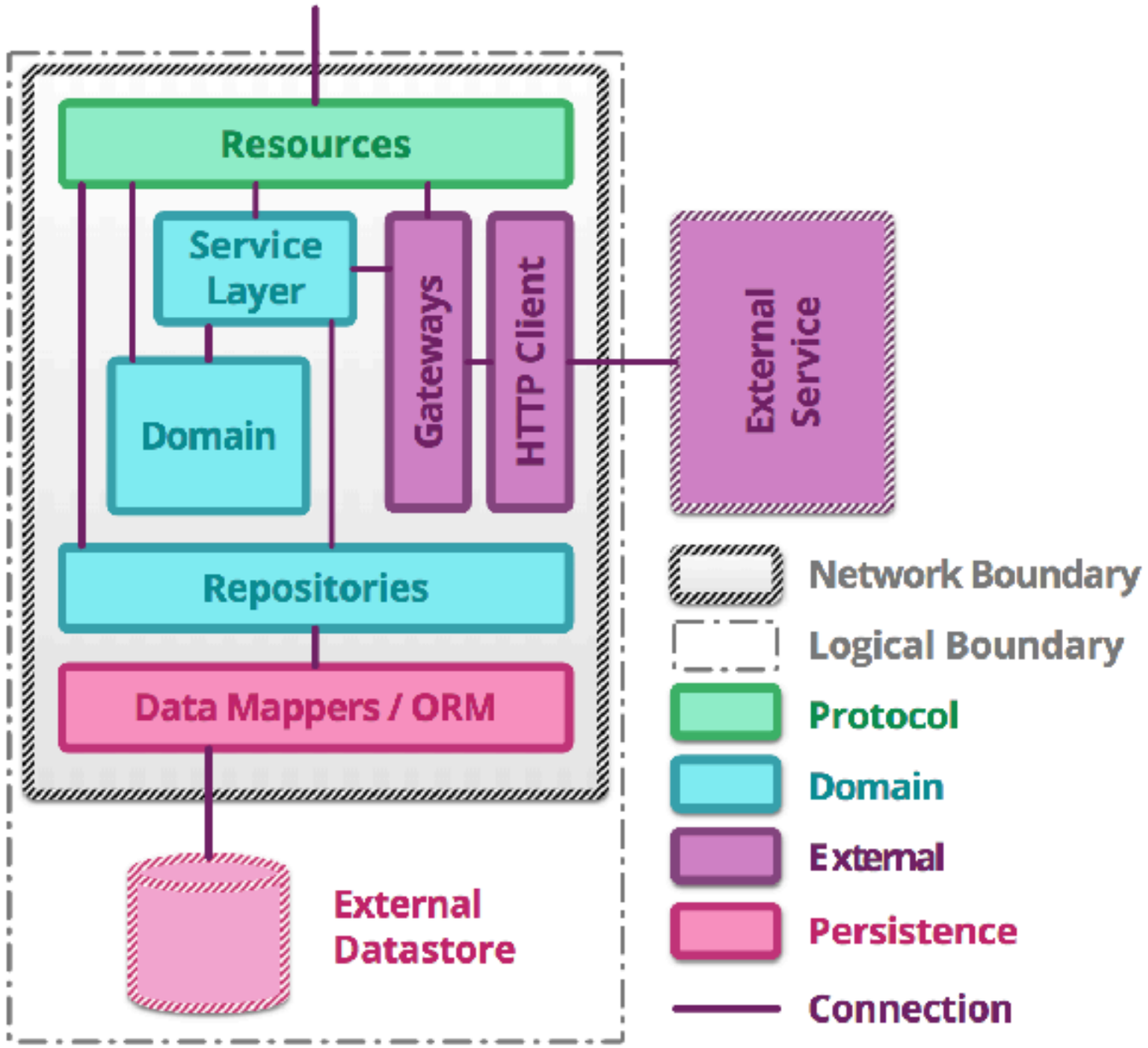
In Practices with Java Technology



Build pipeline

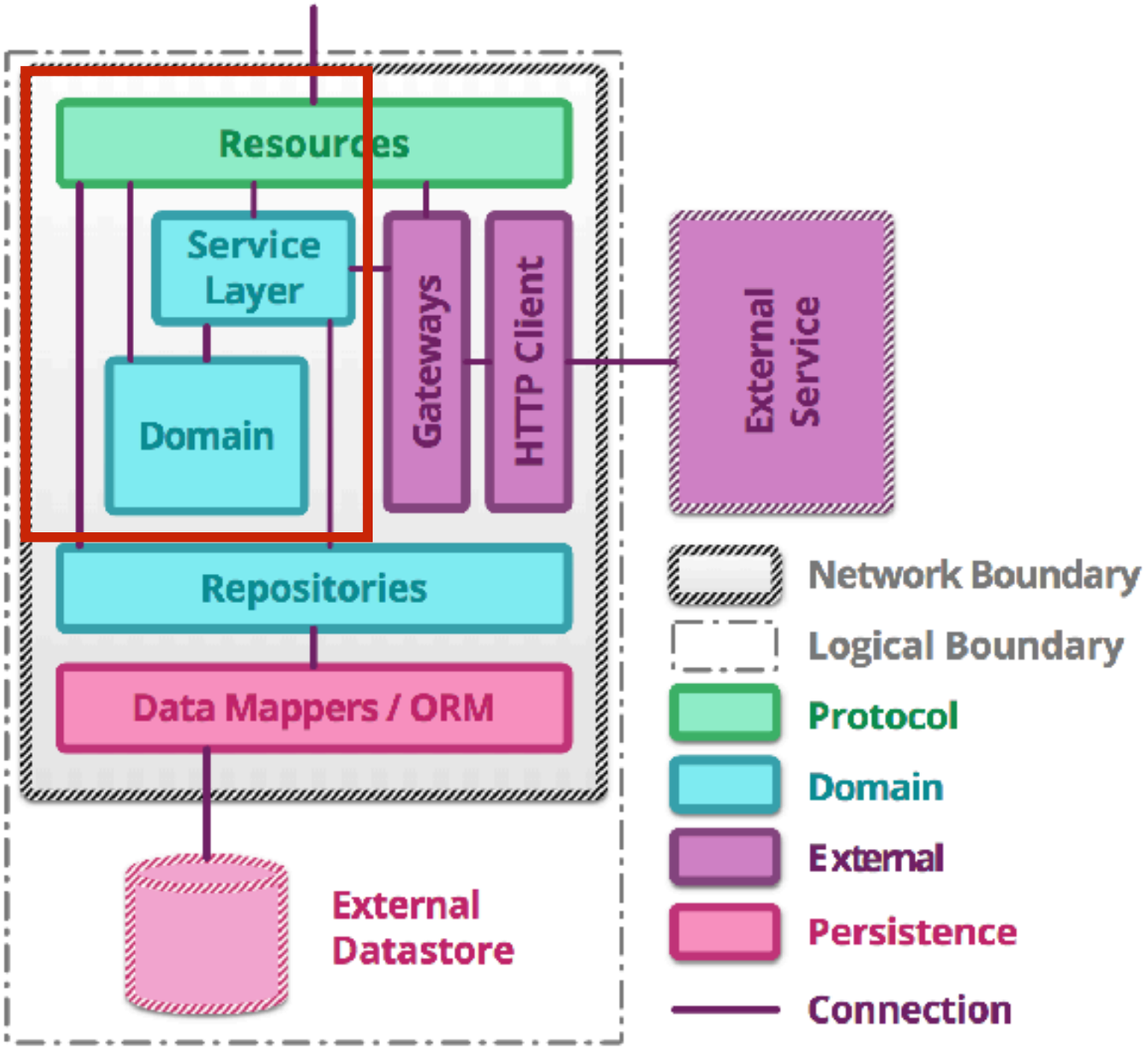
Develop Microservices with Spring Boot

Service Structure

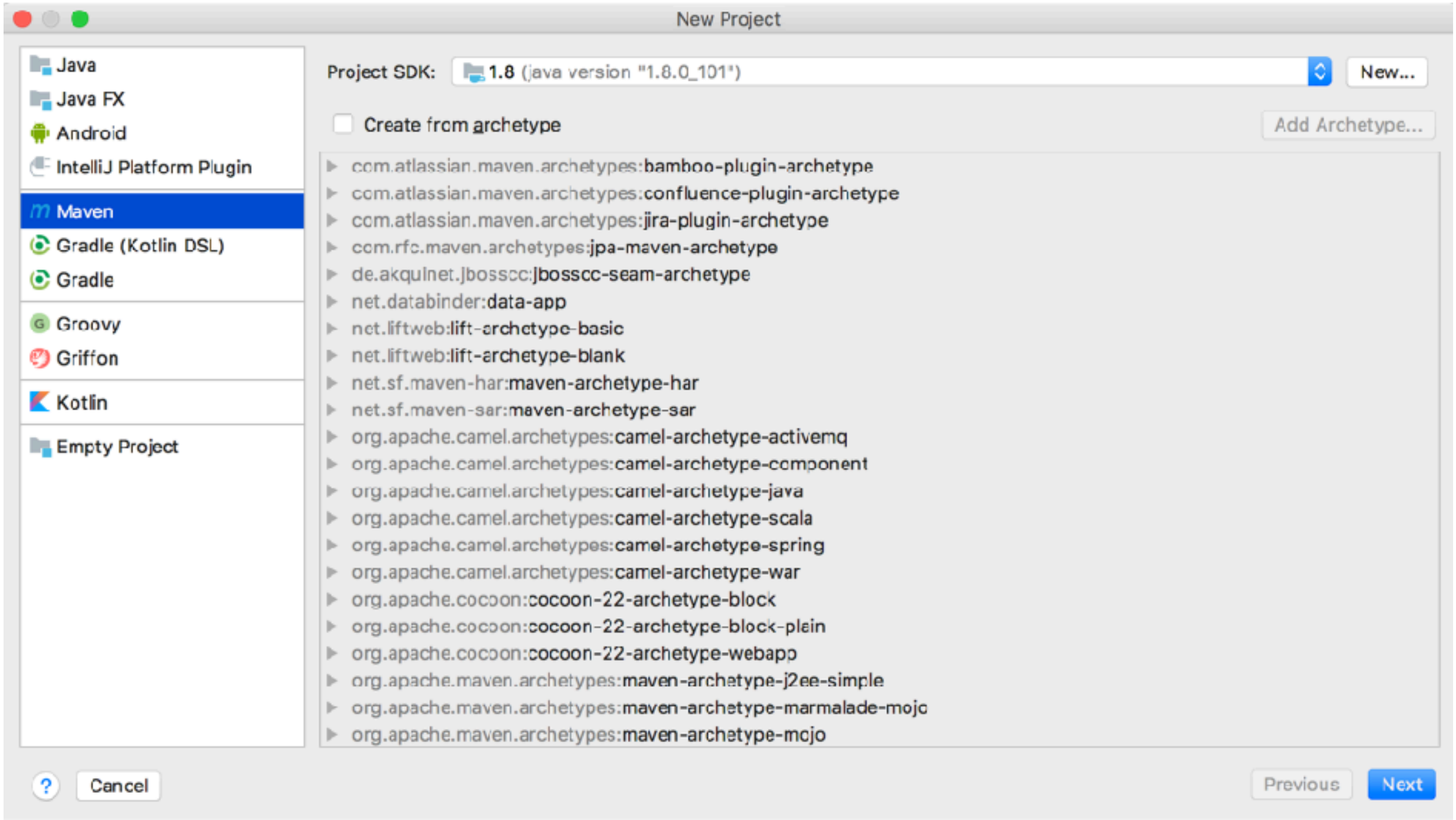


Hello Spring Boot 2.0

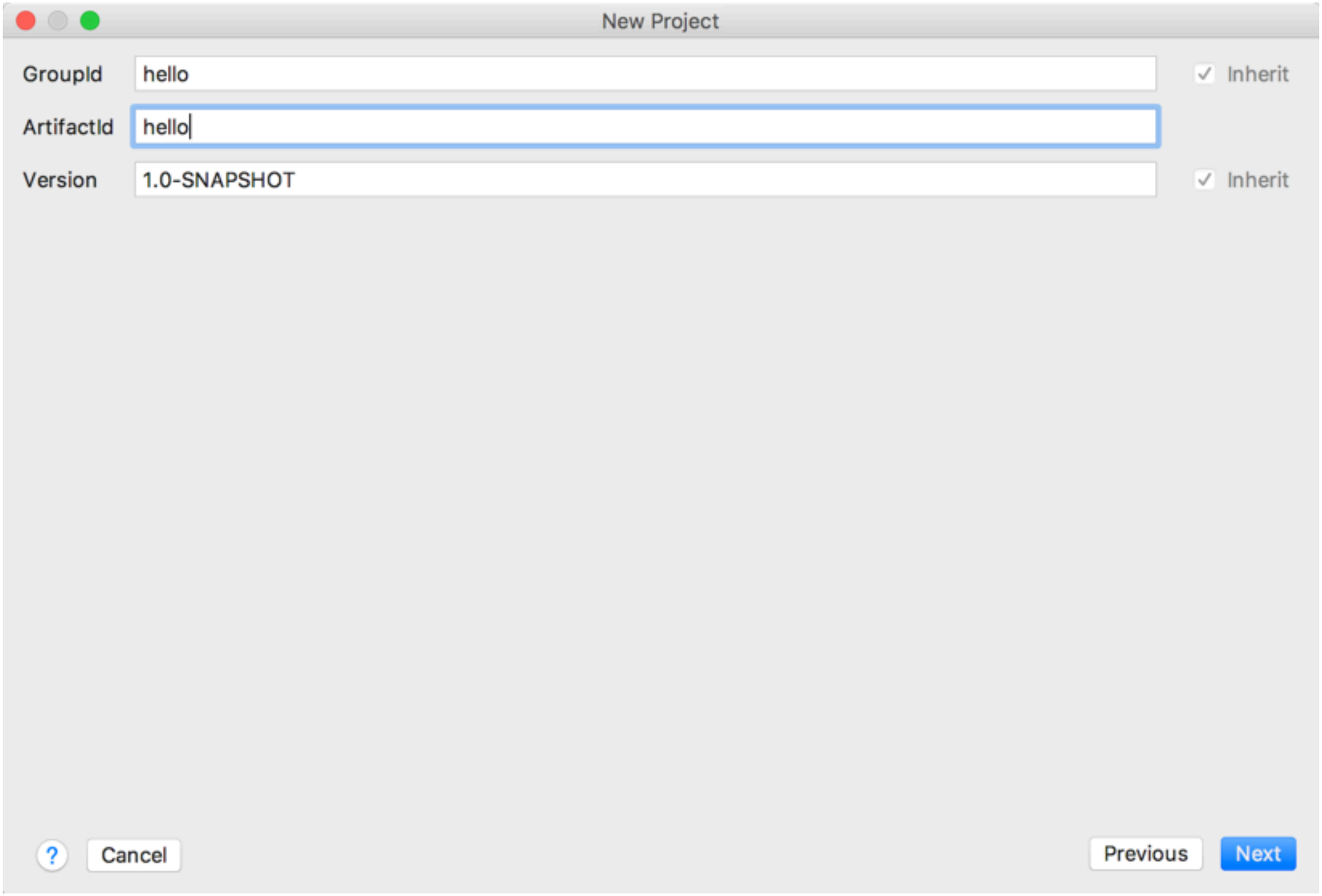
Service Structure



1. Create Maven Project



2. Project Name



3. Modify pom.xml (1)

```xml
<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.o
    <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/> <!-- lookup parent from repository -->
    </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>
```

3. Modify pom.xml (2)

```xml
<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>
```

4. Create String boot application

hello.HelloApplication.java

```java
package hello;

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

@SpringBootApplication
public class HelloApplication {

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

}
```

5. Create model class

hello.model.Hello.java

```
package hello.domain;

public class Hello {

    private String message;

    public Hello(String message) {
        this.message = message;
    }

    public String getMessage() {
        return message;
    }

    public void setMessage(String message) {
        this.message = message;
    }
}
```

6. Create REST Controller

hello.controller.HelloController.java

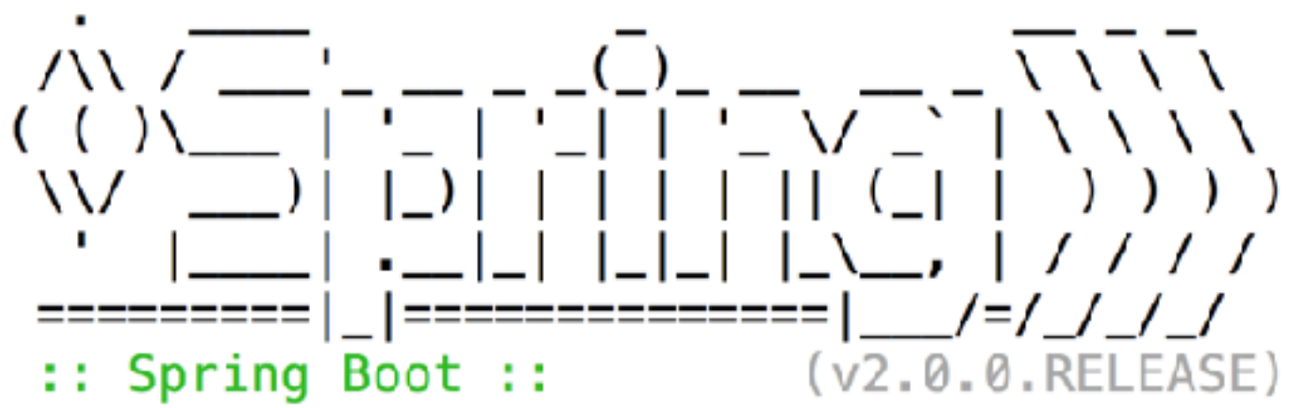
```java
package hello.controller;

import hello.domain.Hello;
import org.springframework.web.bind.annotation.GetMapping;
import org.springframework.web.bind.annotation.PathVariable;
import org.springframework.web.bind.annotation.RestController;

@RestController
public class HelloController {

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

}
```

7. Compile and Packaging

$mvn clean package

8. Run

$java -jar target/hello.jar

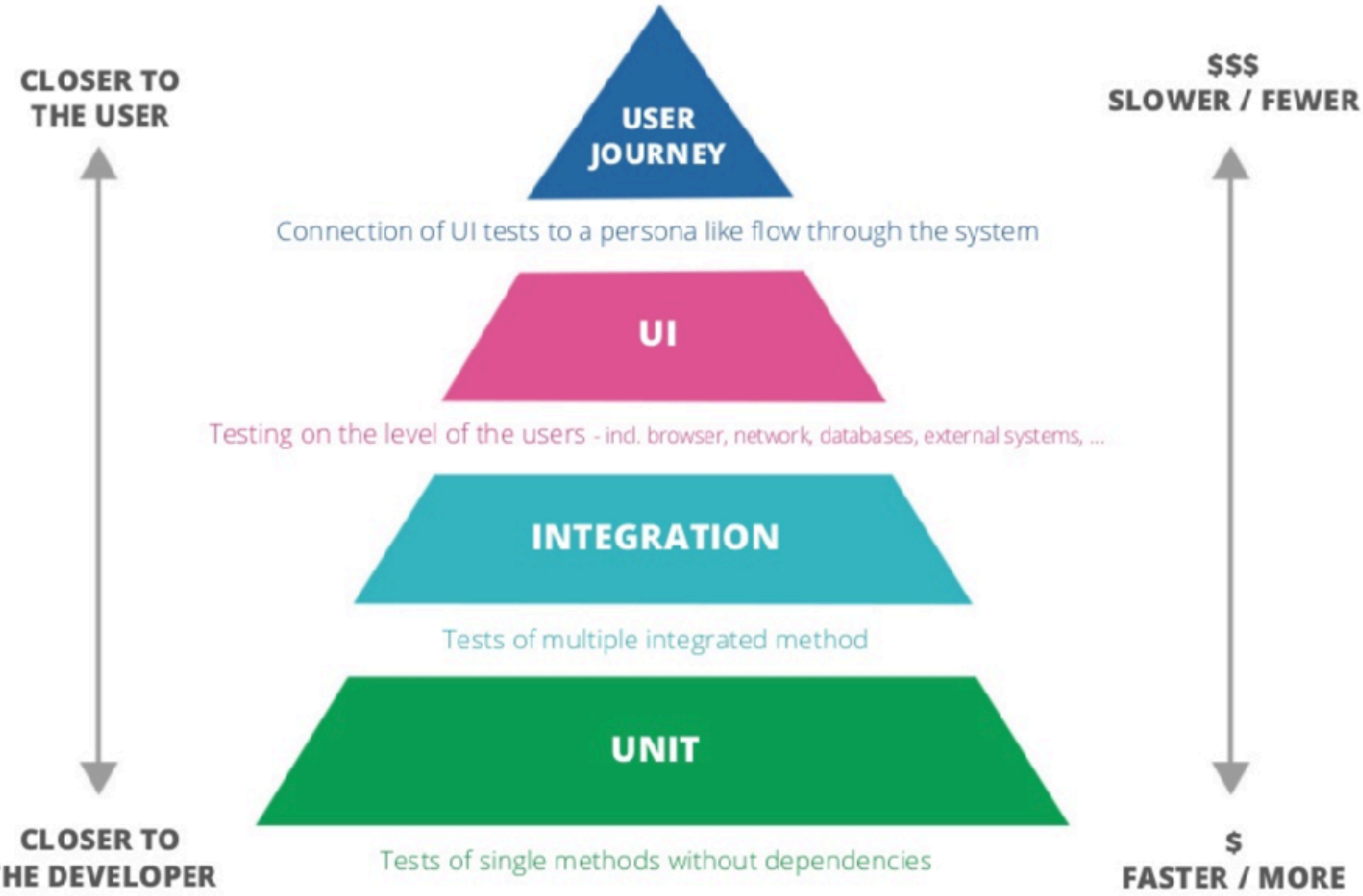


```
 :: Spring Boot ::        (v2.0.0.RELEASE)

2018-03-05 23:37:18.018  INFO 30560 --- [           mai
                    : 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/h
2018-03-05 23:37:18.023  INFO 30560 --- [           mai
                    : No active profile set, falling back t
2018-03-05 23:37:18.138  INFO 30560 --- [           mai
```

9. Open in browser

http://localhost:8080/hello/somkiat

How to test the Hello service ?



Unit tests

How to use model ?

```
public class HelloTest {

    @Test
    public void success_to_create_model_with_constructor() {
        Hello hello = new Hello("Somkiat");
        assertEquals( expected: "Somkiat", hello.getMessage());
    }

}
```

API/Controller tests

How to use controller ?

Spring boot provides MockMvc to test Controller

```java
package hello.controller;

import hello.domain.Hello;
import org.springframework.web.bind.annotation.GetMapping;
import org.springframework.web.bind.annotation.PathVariable;
import org.springframework.web.bind.annotation.RestController;

@RestController
public class HelloController {

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

}
```

API/Controller tests

```java
@RunWith(SpringRunner.class)
@WebMvcTest(controllers = HelloController.class)
public class HelloControllerTest {

    @Autowired
    private MockMvc mockMvc;

    @Test
    public void shouldReturnHelloSomkiat() throws Exception {
        mockMvc.perform(get( urlTemplate: "/hello/somkiat"))
                .andExpect(
                        jsonPath( expression: "$.message")
                                .value( expectedValue: "Hello somkiat"))
                .andExpect(status().is2xxSuccessful());
    }

}
```

Compile with testing

$mvn clean package

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

% of Code/Test coverage

Add coverage to pom.xml (1)

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

        <plugin>
            <artifactId>maven-compiler-plugin</artifactId>
            <version>2.5.1</version>
            <configuration>
                <source>${java.version}</source>
                <target>${java.version}</target>
                <encoding>${project.build.sourceEncoding}</encoding>
            </configuration>
        </plugin>
```

Add coverage to pom.xml (2)

```xml
<plugin>
    <groupId>org.codehaus.mojo</groupId>
    <artifactId>cobertura-maven-plugin</artifactId>
    <version>2.7</version>
    <configuration>
        <formats>
            <format>html</format>
            <format>xml</format>
        </formats>
    </configuration>
    <executions>
        <execution>
            <phase>package</phase>
            <goals>
                <goal>cobertura</goal>
            </goals>
        </execution>
    </executions>
    <dependencies>
        <dependency>
            <groupId>org.ow2.asm</groupId>
            <artifactId>asm</artifactId>
            <version>5.0.3</version>
        </dependency>
    </dependencies>
</plugin>
```

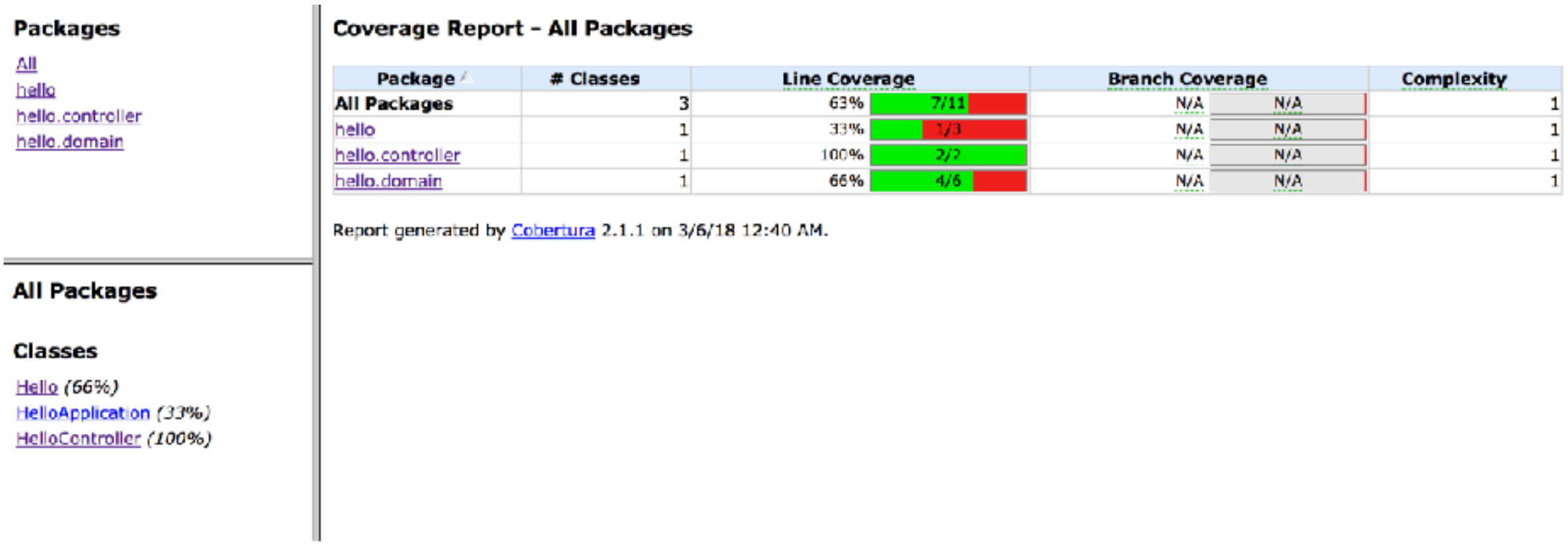
Run test again

$mvn 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/cobertura/index.html



Packages

All
hello
hello.controller
hello.domain

All Packages

Classes

Hello *(66%)*
HelloApplication *(33%)*
HelloController *(100%)*

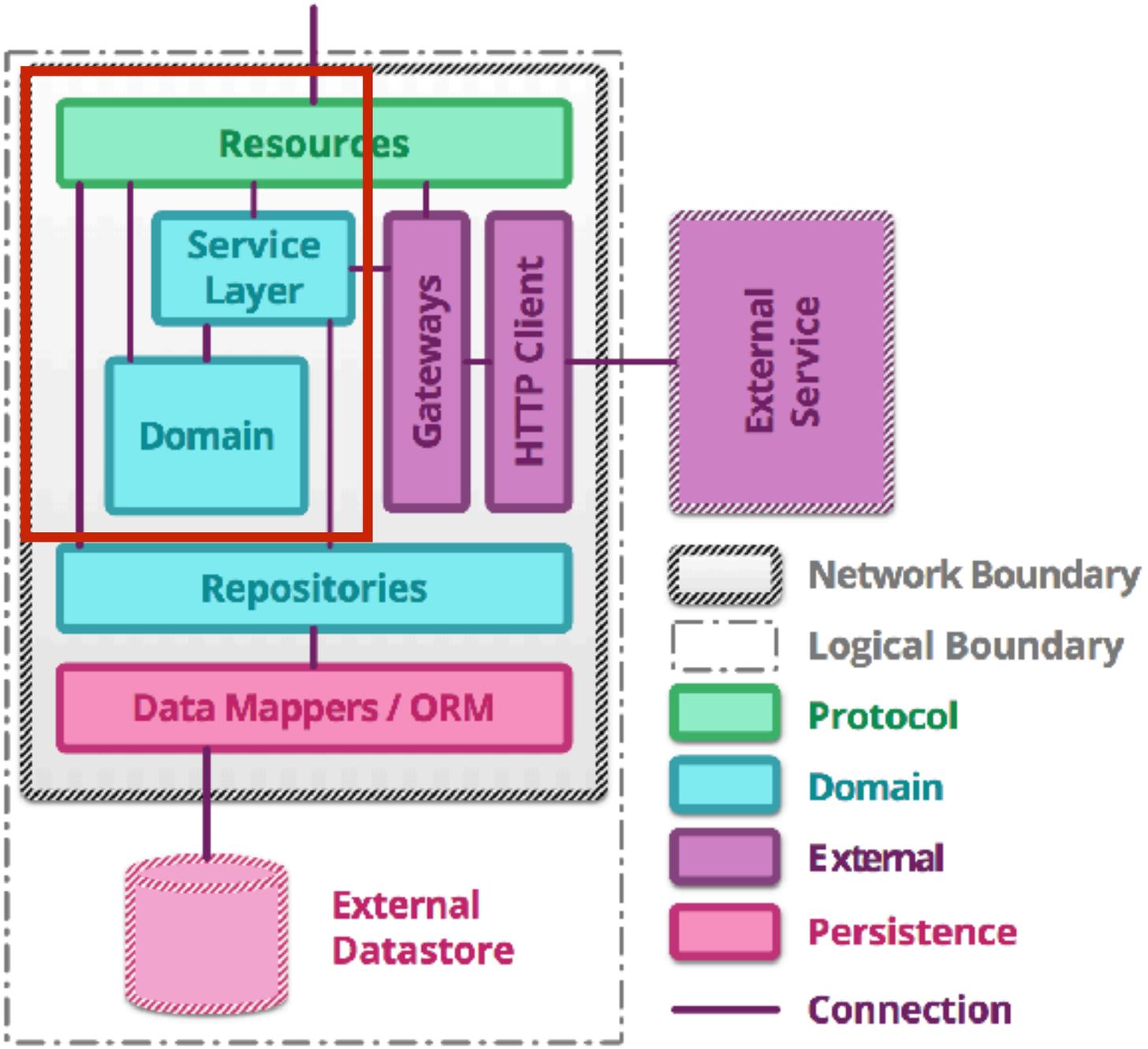
Coverage Report - All Packages

Package	# Classes	Line Coverage	Branch Coverage	Complexity
All Packages	3	63% 7/11	N/A N/A	1
hello	1	33% 1/3	N/A N/A	1
hello.controller	1	100% 2/2	N/A N/A	1
hello.domain	1	66% 4/6	N/A N/A	1

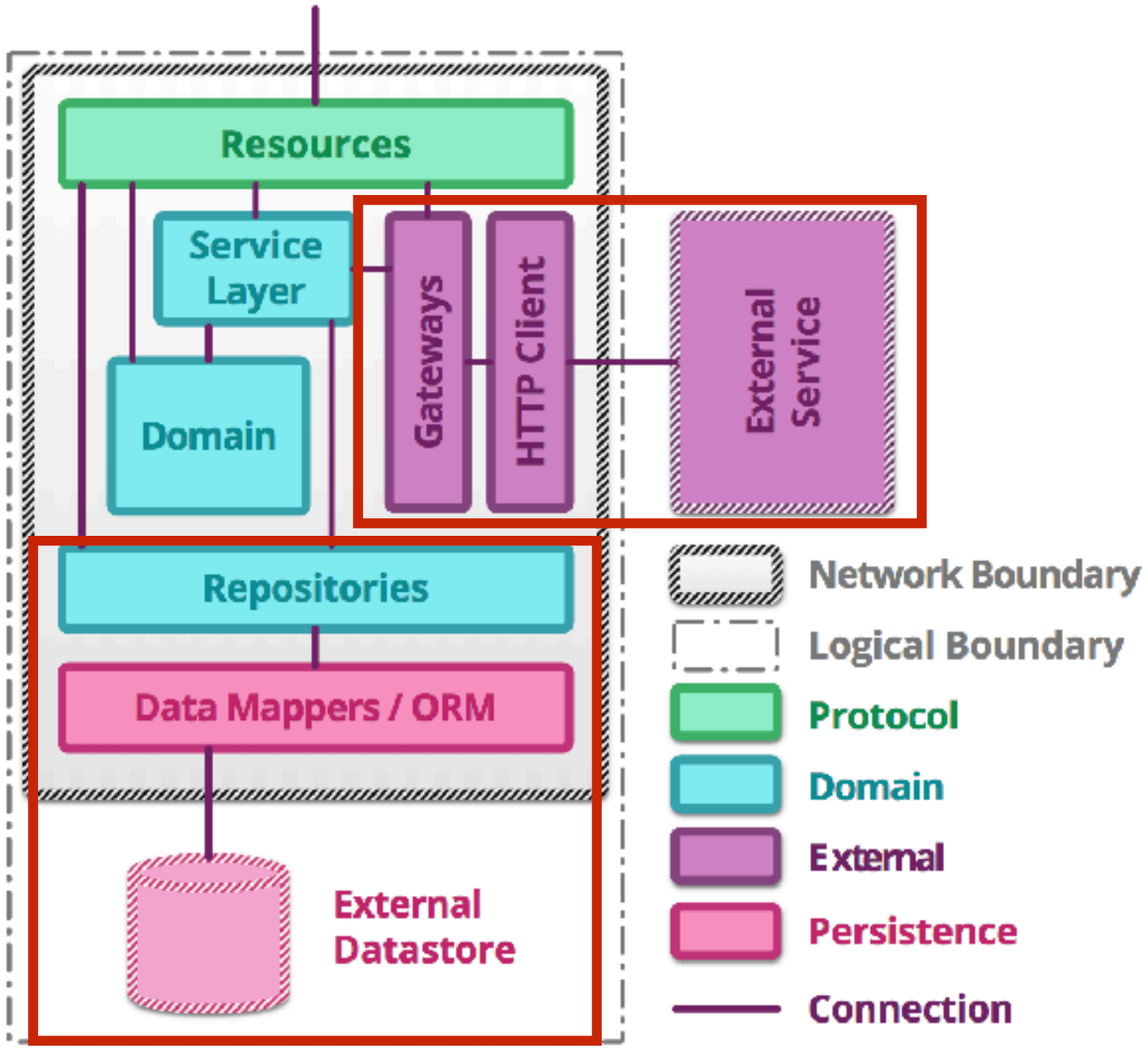
Report generated by Cobertura 2.1.1 on 3/6/18 12:40 AM.

How to improve % of coverage ?

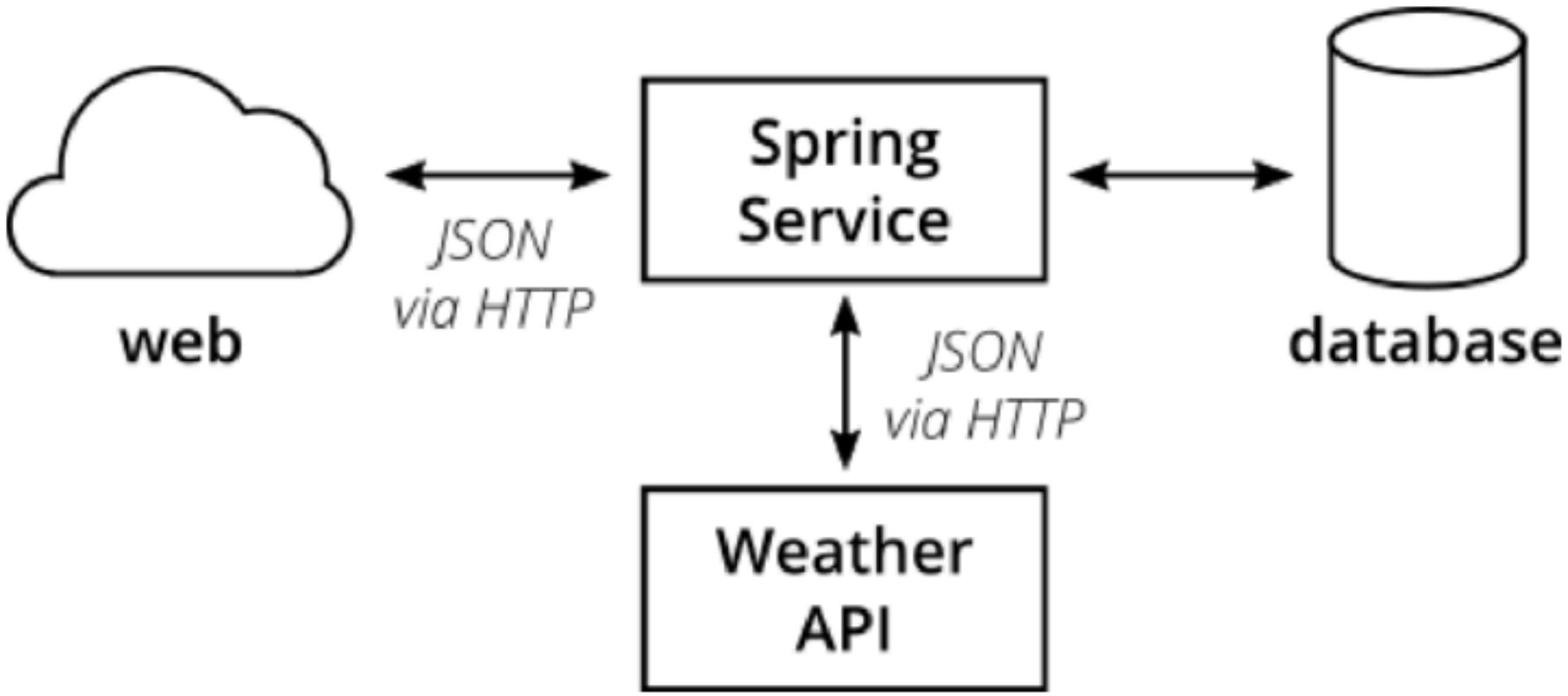
Service Structure



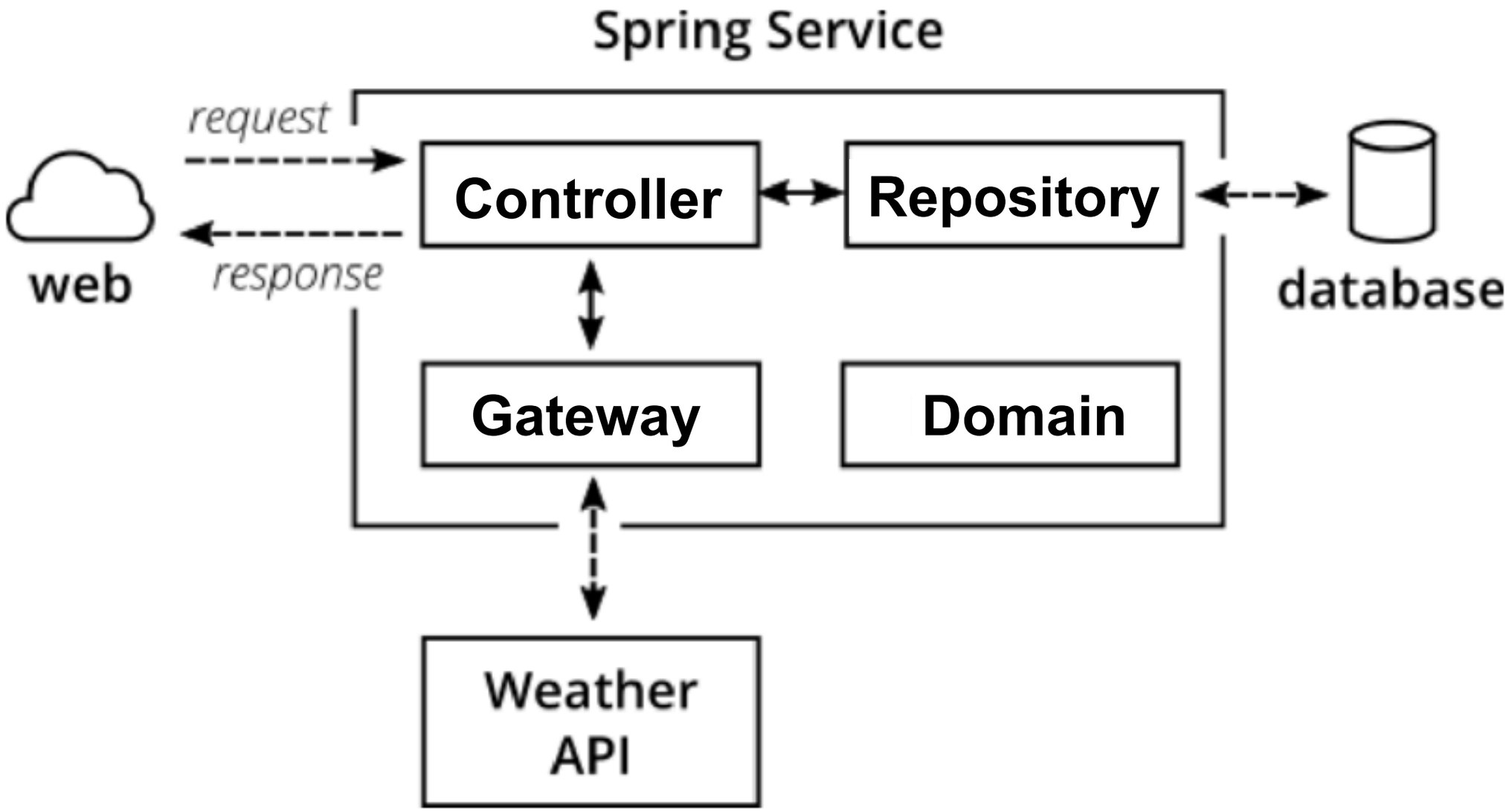
Service Structure



Sample application

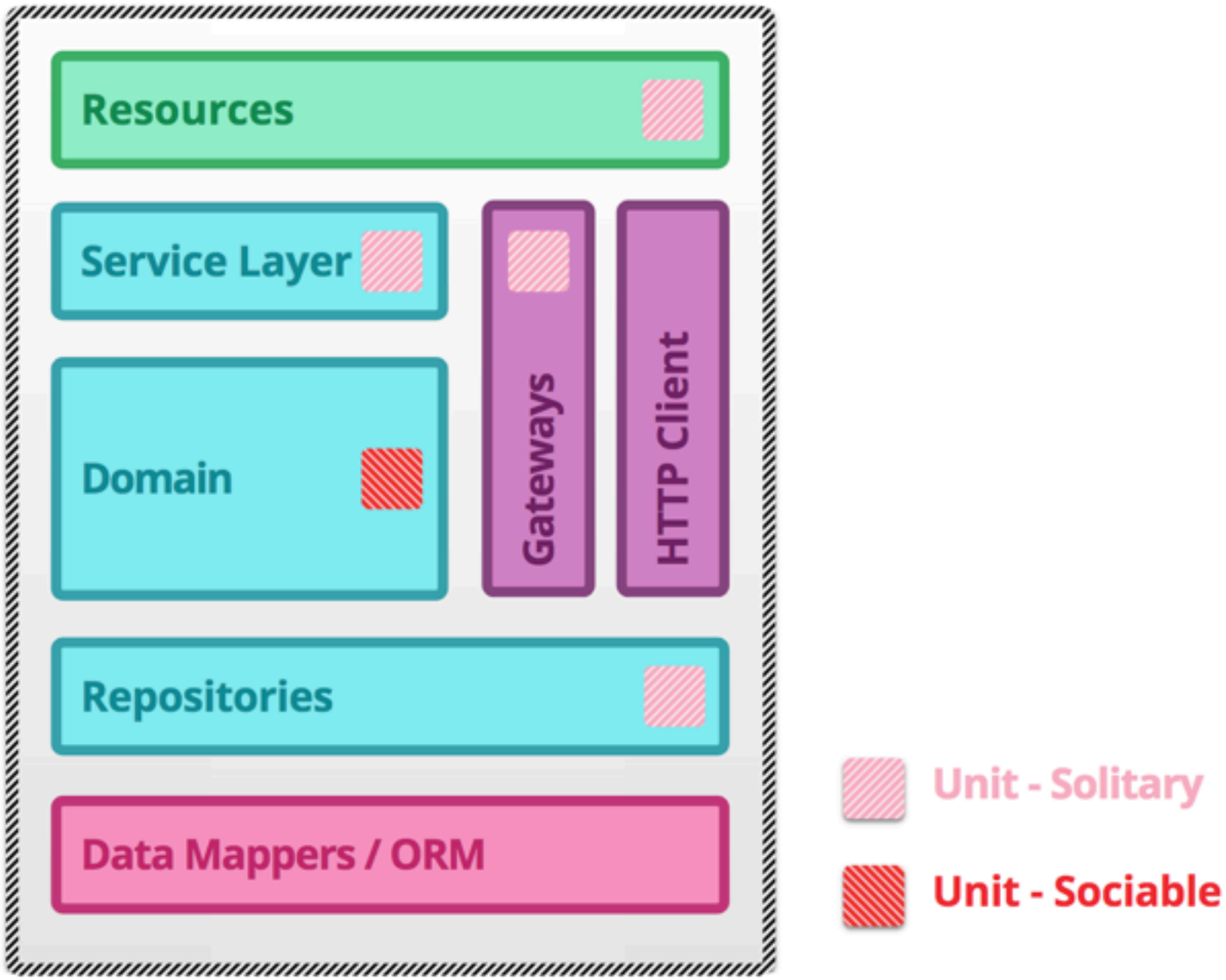


Project structure

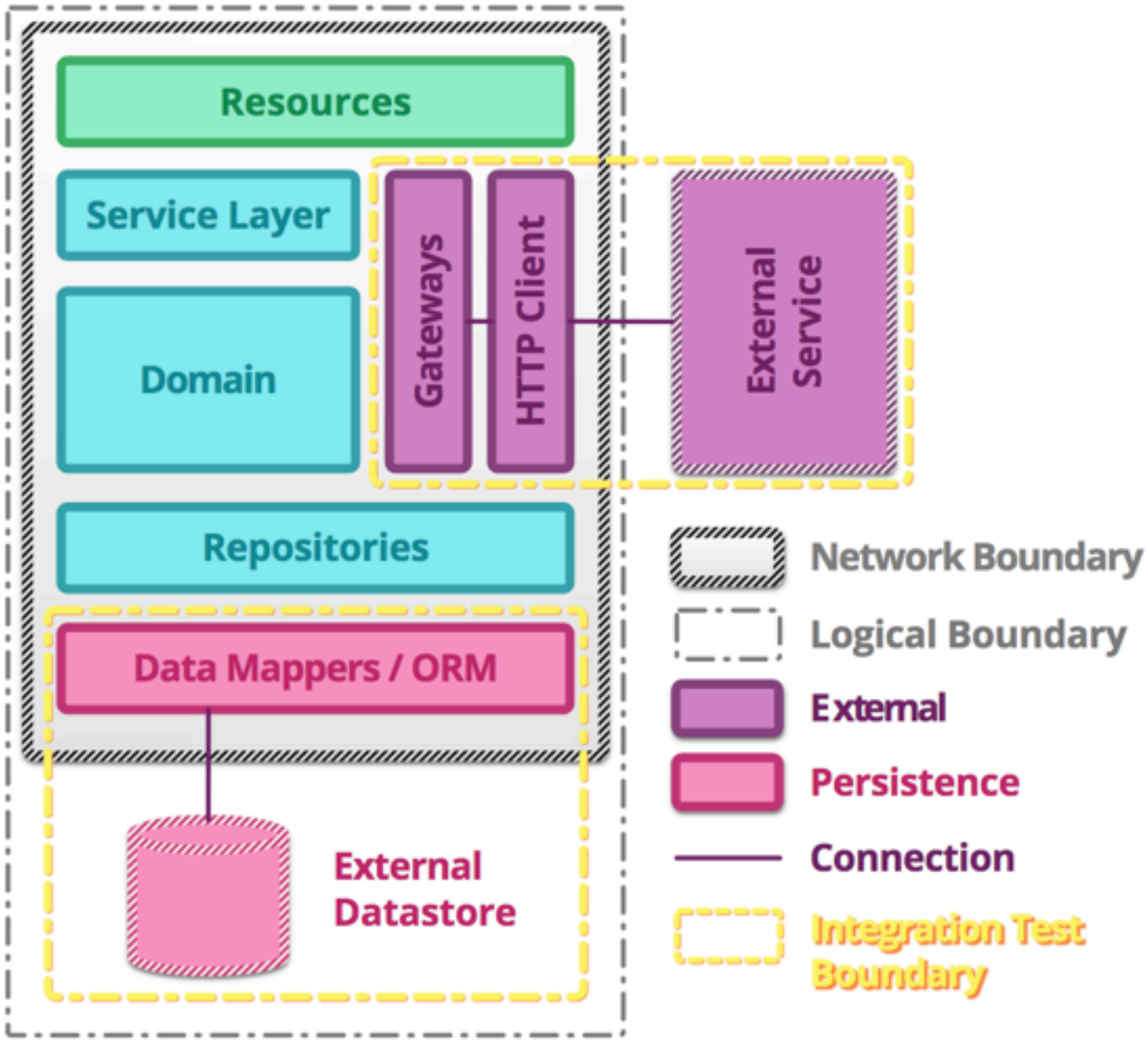


How to test ?

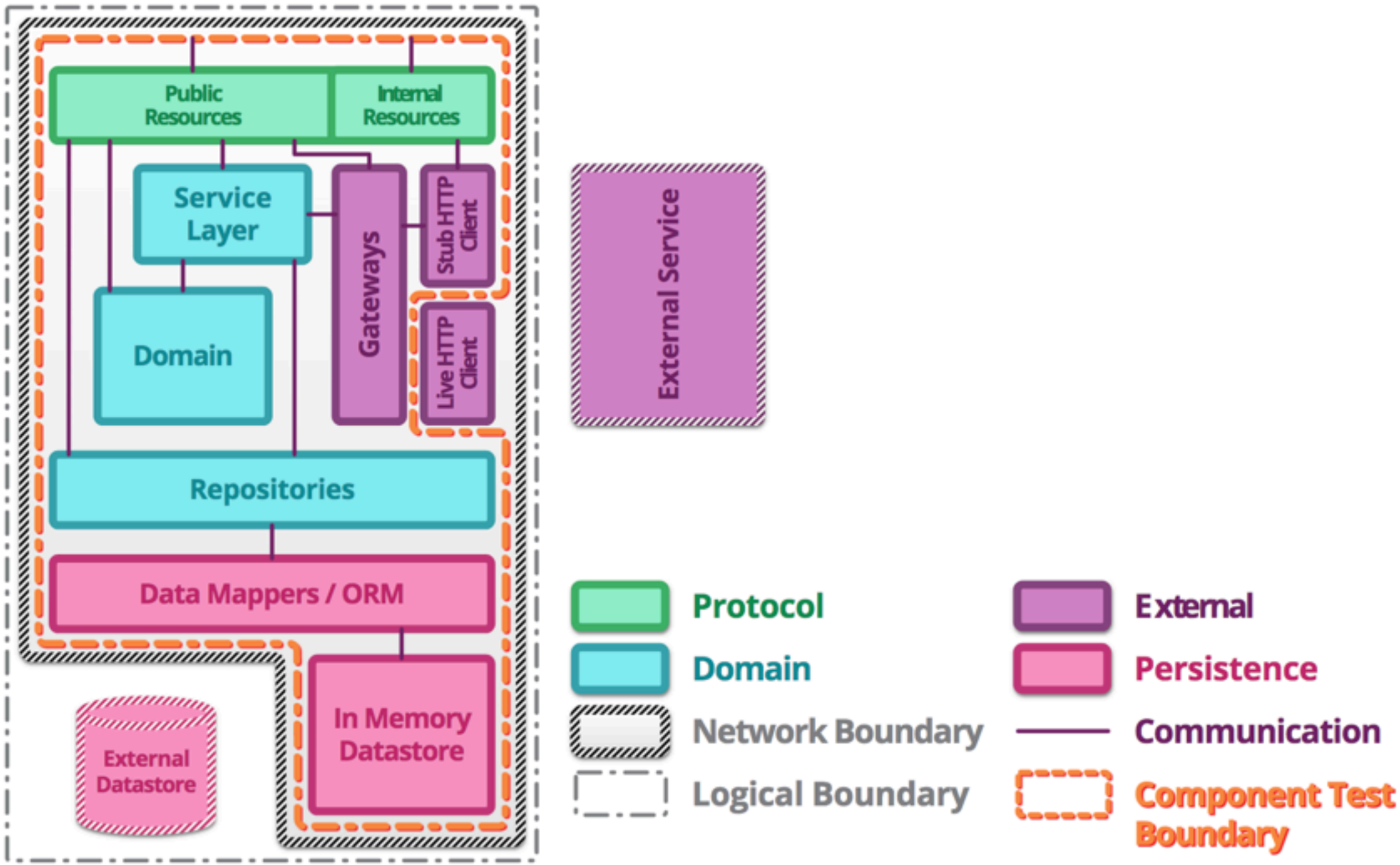
Unit testing



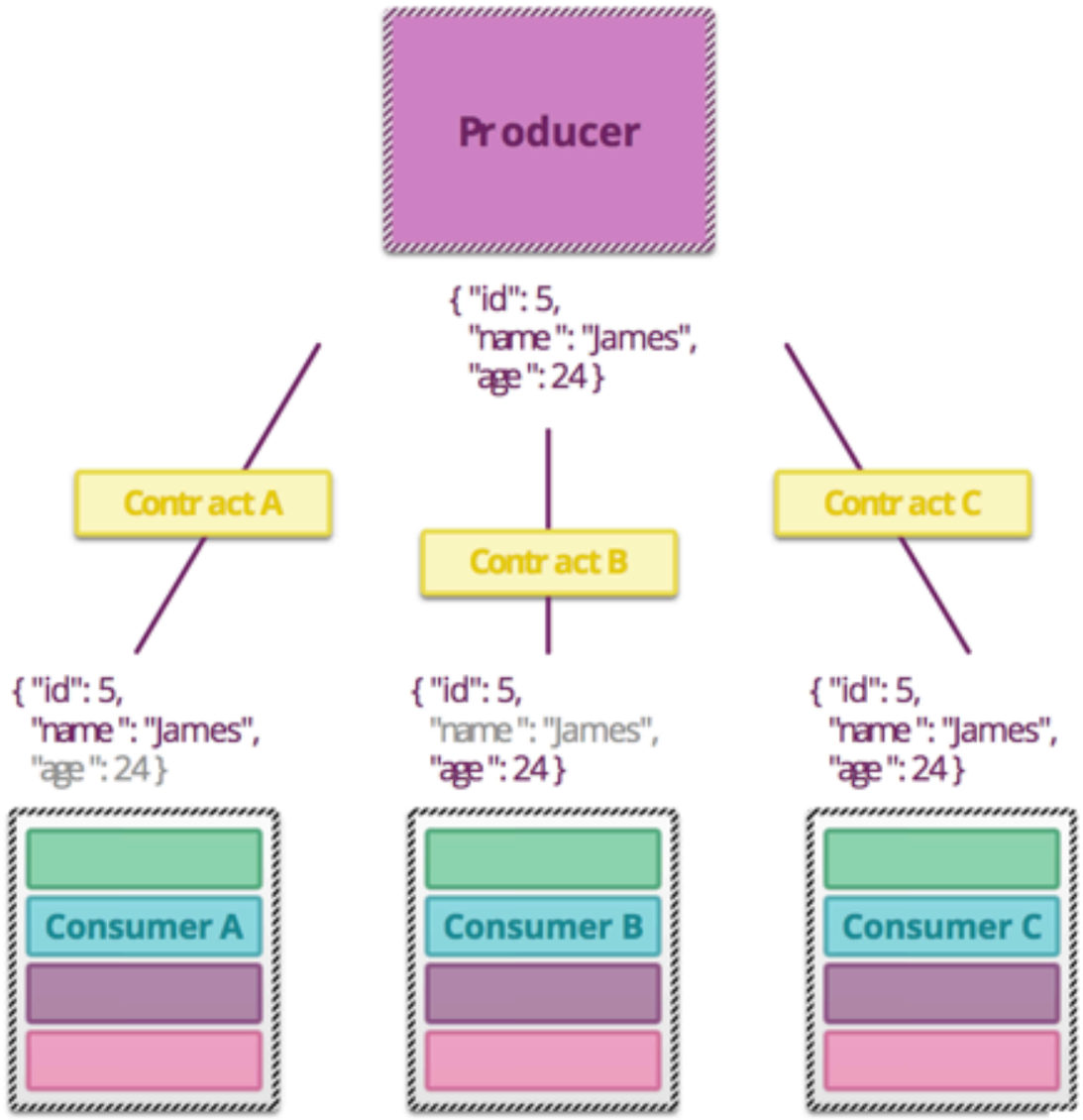
Integration testing



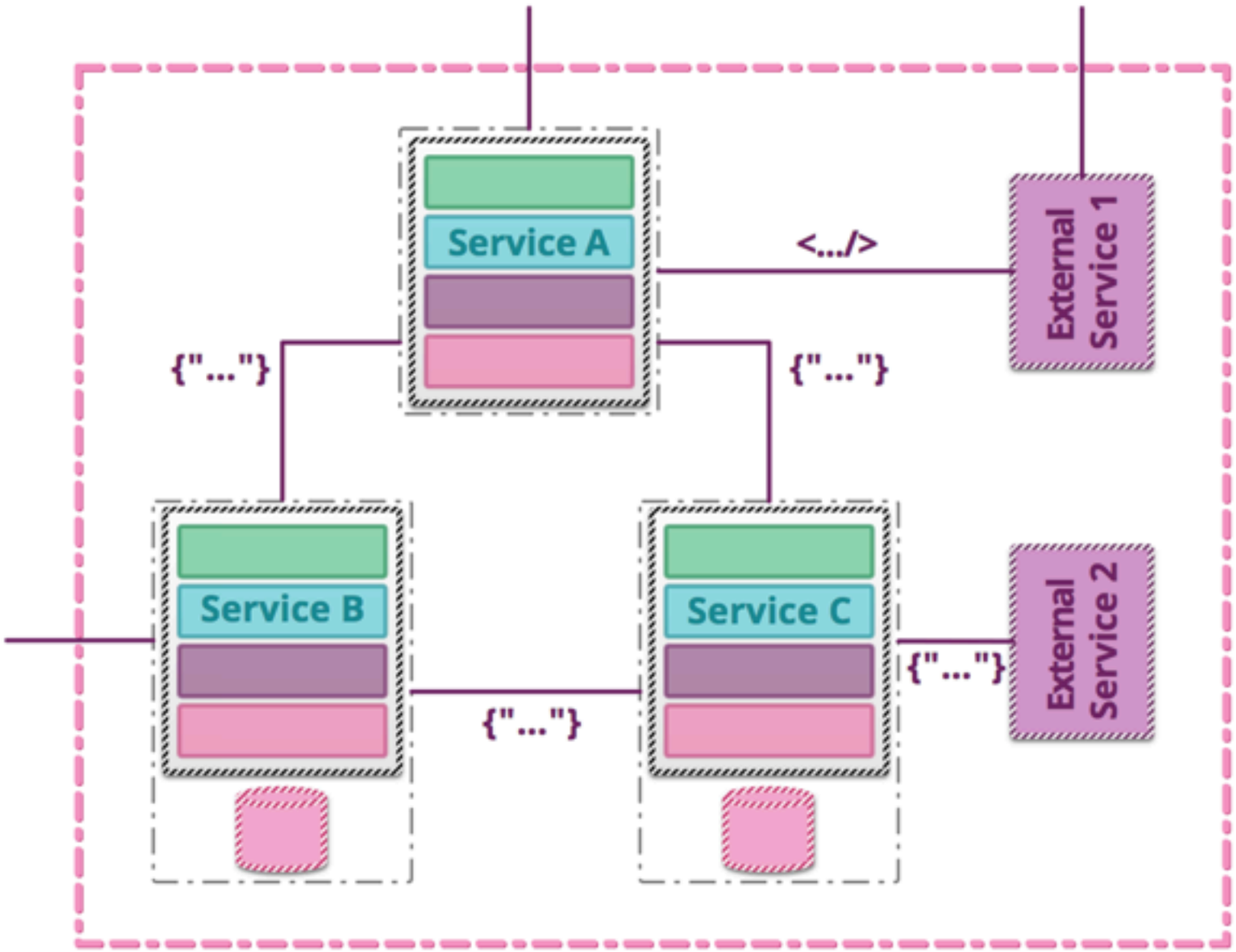
Component testing



Contract testing



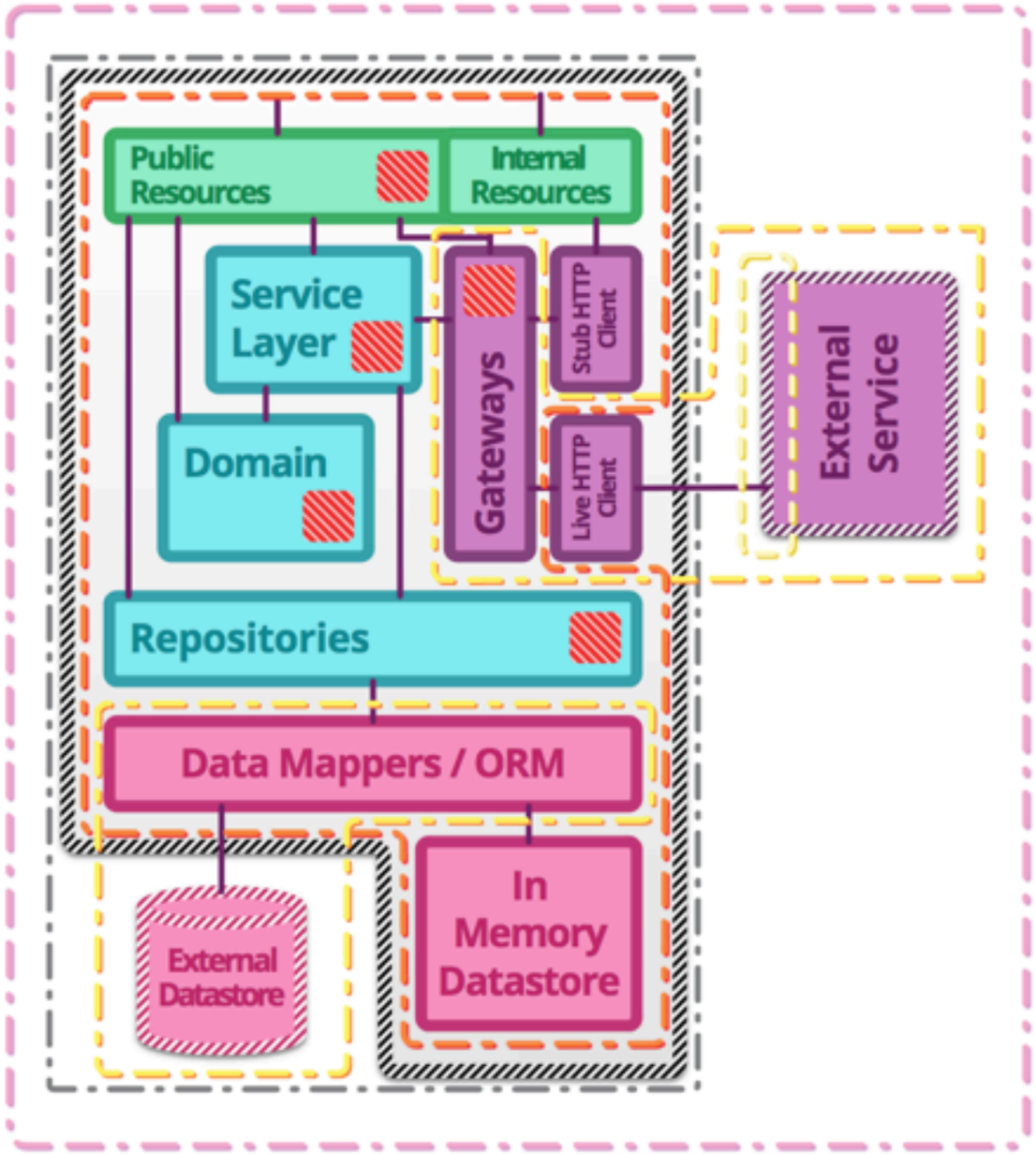
End-to-End testing



Summary

Unit tests : exercise the smallest pieces of testable software in the application to determine whether they behave as expected.

Integration tests : verify the communication paths and interactions between components to detect interface defects.



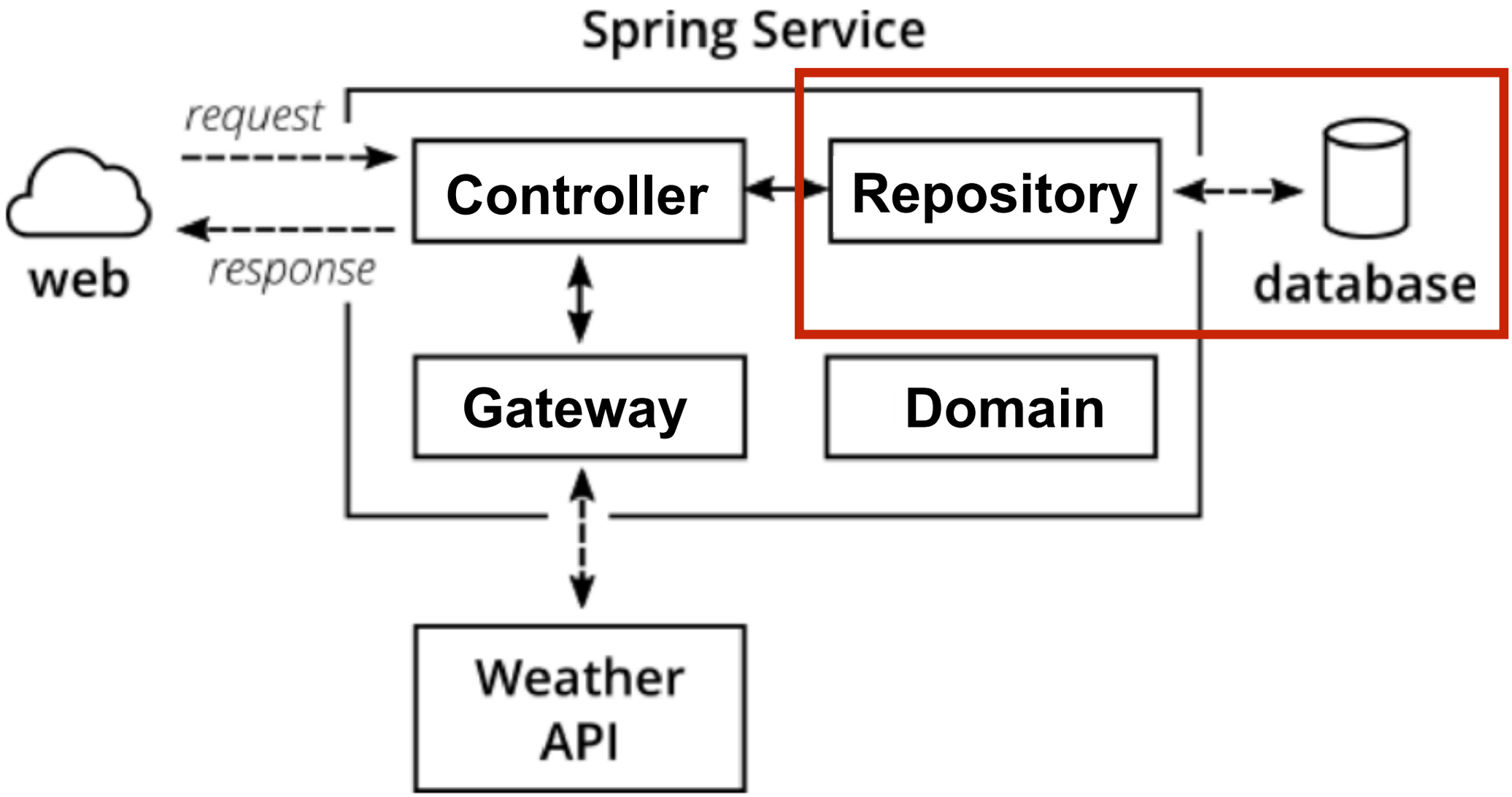
Component tests : limit the scope of the exercised software to a portion of the system under test, manipulating the system through internal code interfaces and using test doubles to isolate the code under test from other components.

Contract tests : verify interactions at the boundary of an external service asserting that it meets the contract expected by a consuming service.

End-to-end tests : verify that a system meets external requirements and achieves its goals, testing the entire system, from end to end.

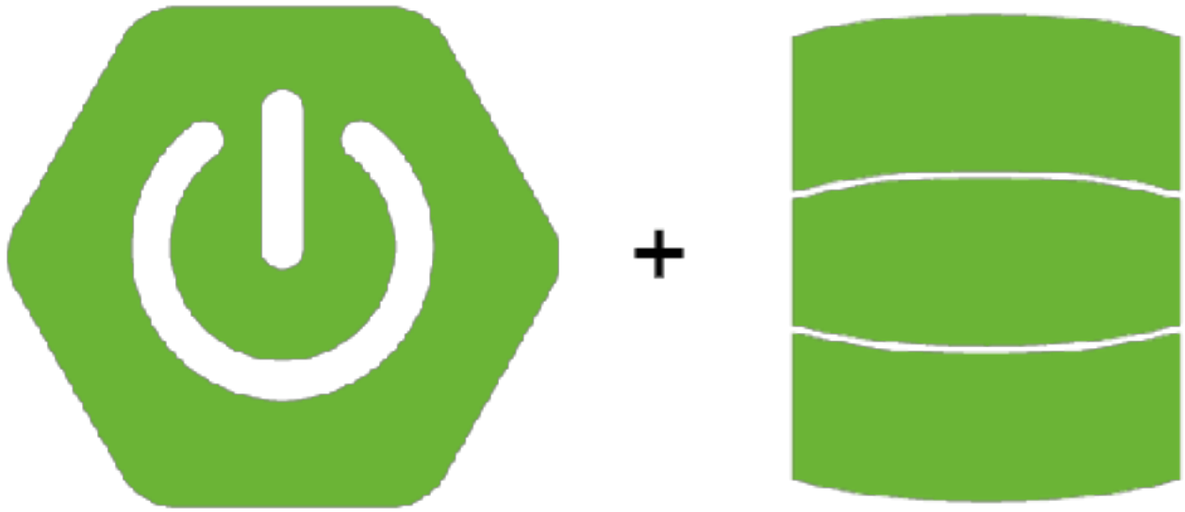
Let’s workshop

Working with repository



Working with repository

We're using Spring Data



Modify pom.xml

Add library of Spring Data

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

Modify pom.xml

Add library of Persistence/data store

```
<dependency>
    <groupId>org.postgresql</groupId>
    <artifactId>postgresql</artifactId>
    <version>42.1.1</version>
</dependency>
```

Add data store config

In src/main/resources

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

Create repository interface

hello.repository.PersonRepository.java

```
public interface PersonRepository
        extends CrudRepository<Person, String> {

    Optional<Person> findByFirstName(String name);

}
```

Create Entity class

hello.repository.Person.java

```
@Entity
public class Person {

	@Id
	@GeneratedValue(strategy = GenerationType.AUTO)
	private int id;
	private String firstName;
	private String lastName;

	public Person() {
	}

	public Person(String firstName, String lastName) {
		this.firstName = firstName;
		this.lastName = lastName;
	}
```

Create new controller

hello.repository.HelloControllerWithRepository.java

```
public class HelloControllerWithRepository {

    private final PersonRepository personRepository;

    @Autowired
    public HelloControllerWithRepository(PersonRepository personRepository) {
        this.personRepository = personRepository;
    }

    @GetMapping("/hello/data/{name}")
    public Hello sayHi(@PathVariable String name) {
        Optional<Person> foundPerson = personRepository.findByName(name);
        String result = foundPerson
                .map(person -> String.format("Hello %s", person.getFirstName()))
                .orElse( other: "Data not found");
        return new Hello(result);
    }

}
```

Run test and package

$mvn 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
------------------------------------------------------------------------
```

Run your application

$java -jar target/hello.jar

```
org.postgresql.util.PSQLException: Connection to 127.0.0.1:15432 refused. Check that th
 the postmaster is accepting TCP/IP connections.
        at org.postgresql.core.v3.ConnectionFactoryImpl.openConnectionImpl(ConnectionFa
jar!/:42.1.1]
        at org.postgresql.core.ConnectionFactory.openConnection(ConnectionFactory.java:
        at org.postgresql.jdbc.PgConnection.<init>(PgConnection.java:194) ~[postgresql-
at org.postgresql.Driver.makeConnection(Driver.java:450) ~[postgresql-42.1.1.ja
at org.postgresql.Driver.connect(Driver.java:252) ~[postgresql-42.1.1.jar!/:42.
at com.zaxxer.hikari.util.DriverDataSource.getConnection(DriverDataSource.java:
at com.zaxxer.hikari.util.DriverDataSource.getConnection(DriverDataSource.java:
at com.zaxxer.hikari.pool.PoolBase.newConnection(PoolBase.java:365) [HikariCP-2
at com.zaxxer.hikari.pool.PoolBase.newPoolEntry(PoolBase.java:194) [HikariCP-2.
at com.zaxxer.hikari.pool.HikariPool.createPoolEntry(HikariPool.java:460) [Hika
at com.zaxxer.hikari.pool.HikariPool.checkFailFast(HikariPool.java:534) [Hikari
at com.zaxxer.hikari.pool.HikariPool.<init>(HikariPool.java:115) [HikariCP-2.7.
at com.zaxxer.hikari.HikariDataSource.getConnection(HikariDataSource.java:112)
```

Coverage report

Packages

All
hello
hello.controller
hello.domain
hello.repository

All Packages

Classes

Hello *(65%)*
HelloApplication *(33%)*
HelloController *(100%)*
HelloControllerWithRepository *(0%)*
Person *(0%)*
PersonRepository *(N/A)*

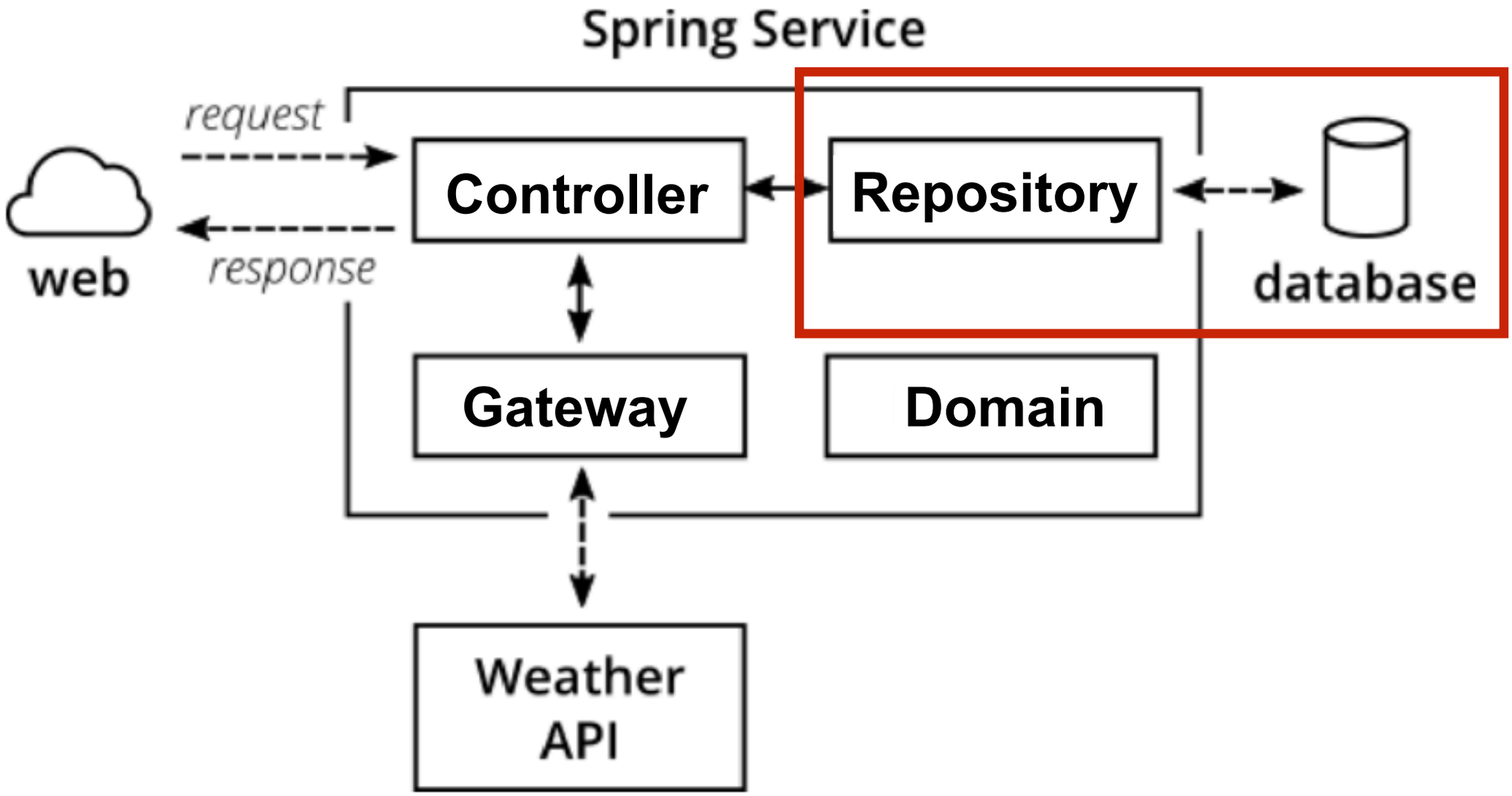
Coverage Report - All Packages

Package	# Classes	Line Coverage		Branch Coverage		Complexity
All Packages	6	25%	7/28	N/A	N/A	1
hello	1	33%	1/3	N/A	N/A	1
hello.controller	2	20%	2/10	N/A	N/A	1
hello.domain	1	66%	4/6	N/A	N/A	1
hello.repository	2	0%	0/9	N/A	N/A	1

Report generated by Cobertura 2.1.1 on 3/6/18 8:52 AM.

How to test ?

How to test with Repository ?



Spring boot provide DataJpaTest

should be add H2 library to pom.xml

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

Repository Testing (1)

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

    @Autowired
    private PersonRepository personRepository;

    @After
    public void clearData() {
        personRepository.deleteAll();
    }
```

Repository Testing (2)

Add a test case

```
@Test
public void shouldSaveAndGetData() throws Exception {
    //Arrange
    Person somkiat = new Person("somkiat", "pui");
    personRepository.save(somkiat);

    Optional<Person> shouldSomkiat
            = personRepository.findByFirstName("somkiat");

    assertEquals( expected: "somkiat",
            shouldSomkiat.get().getFirstName());

}
```

Run test and package

$mvn 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

Packages

All
hello
hello.controller
hello.domain
hello.repository

All Packages

Classes

Hello *(66%)*
HelloApplication *(33%)*
HelloController *(100%)*
HelloControllerWithRepository *(0%*
Person *(88%)*
PersonRepository *(N/A)*

Coverage Report - All Packages

Package	# Classes	Line Coverage		Branch Coverage		Complexity
All Packages	6	53%	15/28	N/A	N/A	1
hello	1	33%	1/3	N/A	N/A	1
hello.controller	2	20%	2/10	N/A	N/A	1
hello.domain	1	66%	4/6	N/A	N/A	1
hello.repository	2	88%	8/9	N/A	N/A	1

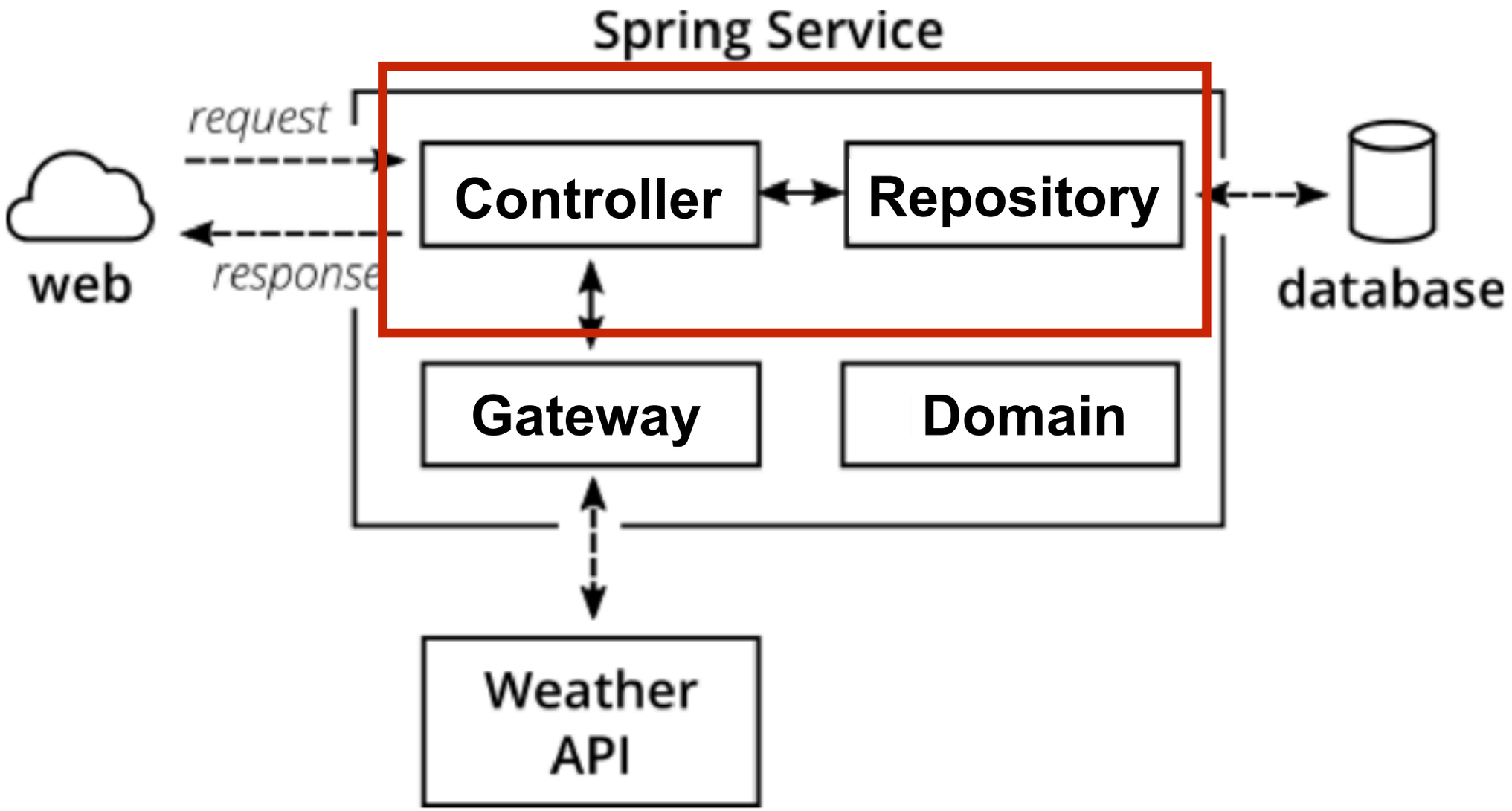
Report generated by Cobertura 2.1.1 on 3/6/18 9:32 AM.

Controller Testing

Unit testing ?

Spring Unit testing with MockMvc ?

Controller Testing with Unit test



Unit test

Use Test Double

In java, use Mockito library

http://site.mockito.org/

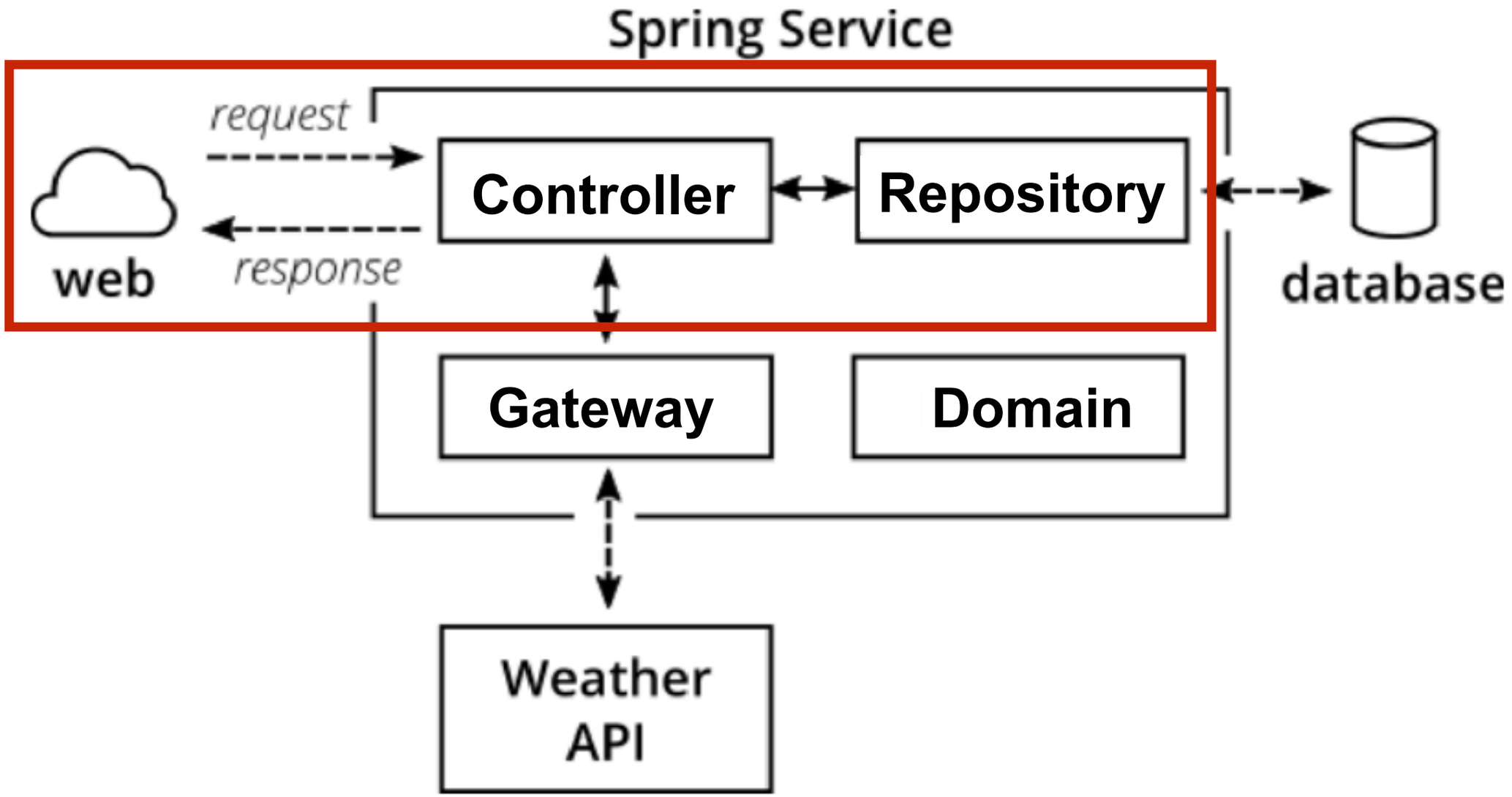
Unit test with Mockito (1)

```
public class HelloControllerWithRepositoryTest {

    private HelloControllerWithRepository controllerWithRepository;

    @Mock
    private PersonRepository personRepository;

    @Before
    public void init() {
        initMocks( testClass: this);
        controllerWithRepository
                = new HelloControllerWithRepository(personRepository);
    }
```

Unit test with Mockito (2)

```java
@Test
public void shouldReturnHelloSomkiat() {
    //Arrange
    Person somkiat = new Person("somkiat", "pui");
    given(personRepository.findByFirstName("somkiat"))
            .willReturn(Optional.of(somkiat));

    // Action
    Hello hello = controllerWithRepository.sayHi( name: "somkiat");

    // Assert
    assertEquals( expected: "Hello somkiat", hello.getMessage());
}
```

Controller Testing with MockMvc



Test with MockMvc (1)

```java
@RunWith(SpringRunner.class)
@WebMvcTest(controllers = HelloControllerWithRepository.class)
public class HelloControllerWithRepositoryMockMvcTest {

    @Autowired
    private MockMvc mockMvc;

    @MockBean
    private PersonRepository personRepository;
```

Test with MockMvc (2)

```
@Test
public void shouldReturnHelloSomkiat() throws Exception {
    //Arrange
    Person somkiat = new Person("somkiat", "pui");
    given(personRepository.findByFirstName("somkiat"))
            .willReturn(Optional.of(somkiat));

    // Action and Assert
    mockMvc.perform(get( urlTemplate: "/hello/data/somkiat"))
            .andExpect(
                    jsonPath( expression: "$.message")
                            .value( expectedValue: "Hello somkiat"))
            .andExpect(status().is2xxSuccessful());
}
```

Coverage report

Packages

All
hello
hello.controller
hello.domain
hello.repository

All Packages

Classes

Hello *(66%)*
HelloApplication *(33%)*
HelloController *(100%)*
HelloControllerWithRepository *(100*
Person *(88%)*
PersonRepository *(N/A)*

Coverage Report - All Packages

Package	# Classes	Line Coverage		Branch Coverage		Complexity
All Packages	6	82%	23/28	N/A	N/A	1
hello	1	33%	1/3	N/A	N/A	1
hello.controller	2	100%	10/10	N/A	N/A	1
hello.domain	1	66%	4/6	N/A	N/A	1
hello.repository	2	88%	8/9	N/A	N/A	1

Report generated by Cobertura 2.1.1 on 3/6/18 1:02 PM.

Run your application

$java -jar target/hello.jar

```
org.postgresql.util.PSQLException: Connection to 127.0.0.1:15432 refused. Check that th
 the postmaster is accepting TCP/IP connections.
        at org.postgresql.core.v3.ConnectionFactoryImpl.openConnectionImpl(ConnectionFa
jar!/:42.1.1]
        at org.postgresql.core.ConnectionFactory.openConnection(ConnectionFactory.java:
        at org.postgresql.jdbc.PgConnection.<init>(PgConnection.java:194) ~[postgresql-
at org.postgresql.Driver.makeConnection(Driver.java:450) ~[postgresql-42.1.1.ja
at org.postgresql.Driver.connect(Driver.java:252) ~[postgresql-42.1.1.jar!/:42.
at com.zaxxer.hikari.util.DriverDataSource.getConnection(DriverDataSource.java:
at com.zaxxer.hikari.util.DriverDataSource.getConnection(DriverDataSource.java:
at com.zaxxer.hikari.pool.PoolBase.newConnection(PoolBase.java:365) [HikariCP-2
at com.zaxxer.hikari.pool.PoolBase.newPoolEntry(PoolBase.java:194) [HikariCP-2.
at com.zaxxer.hikari.pool.HikariPool.createPoolEntry(HikariPool.java:460) [Hika
at com.zaxxer.hikari.pool.HikariPool.checkFailFast(HikariPool.java:534) [Hikari
at com.zaxxer.hikari.pool.HikariPool.<init>(HikariPool.java:115) [HikariCP-2.7.
at com.zaxxer.hikari.HikariDataSource.getConnection(HikariDataSource.java:112)
```

Working with container

Configuration

Monitoring and Metric

Tracing

Service breaker