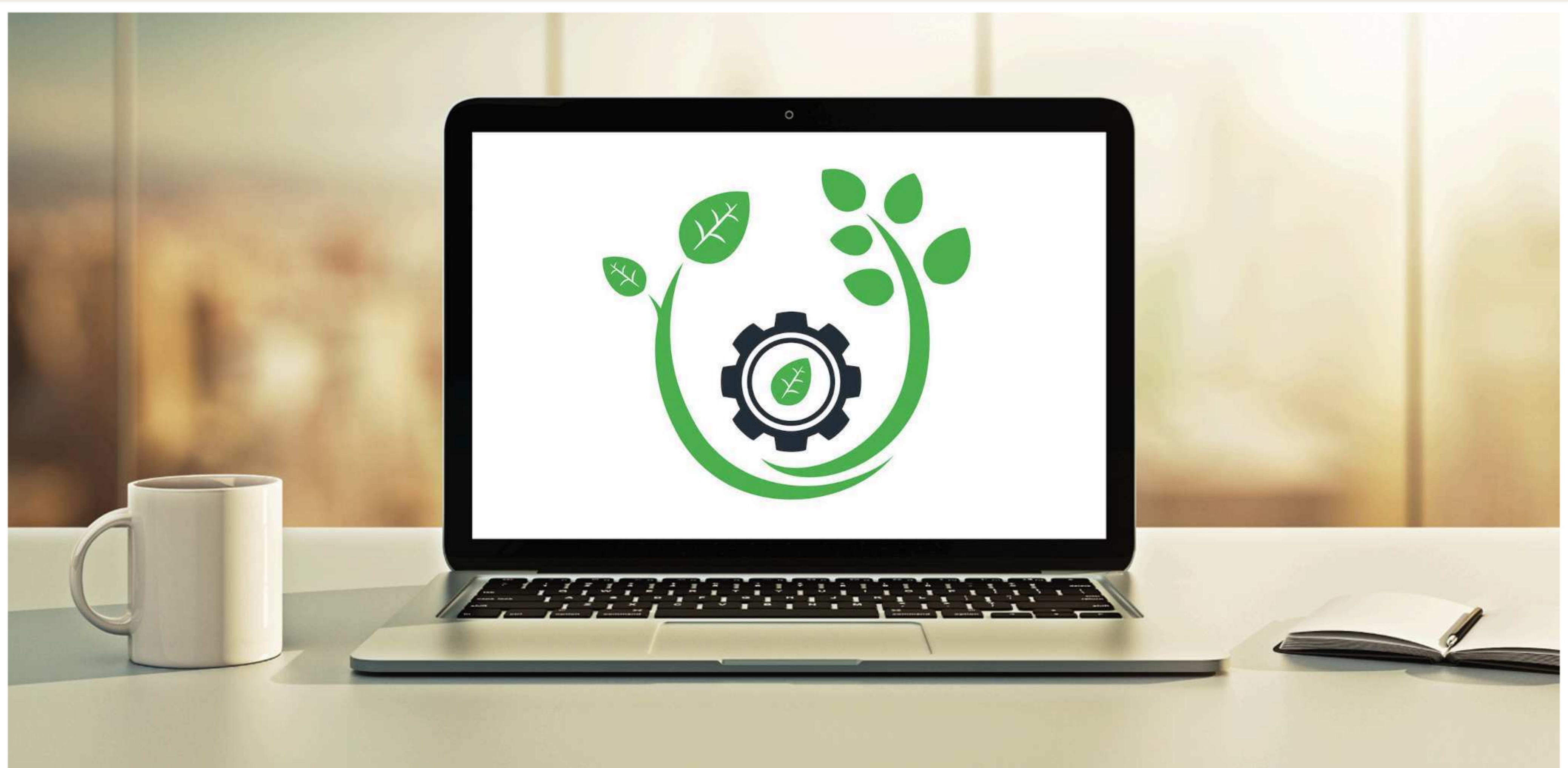
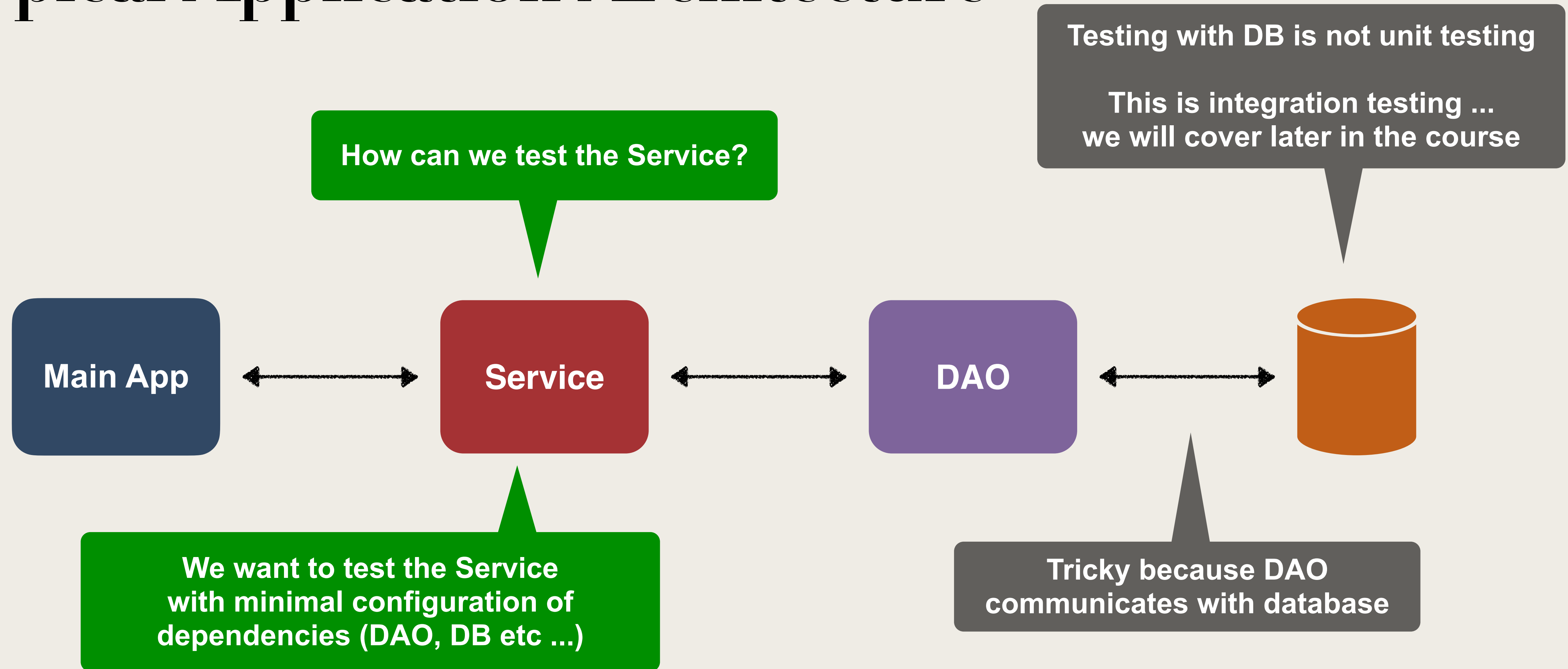


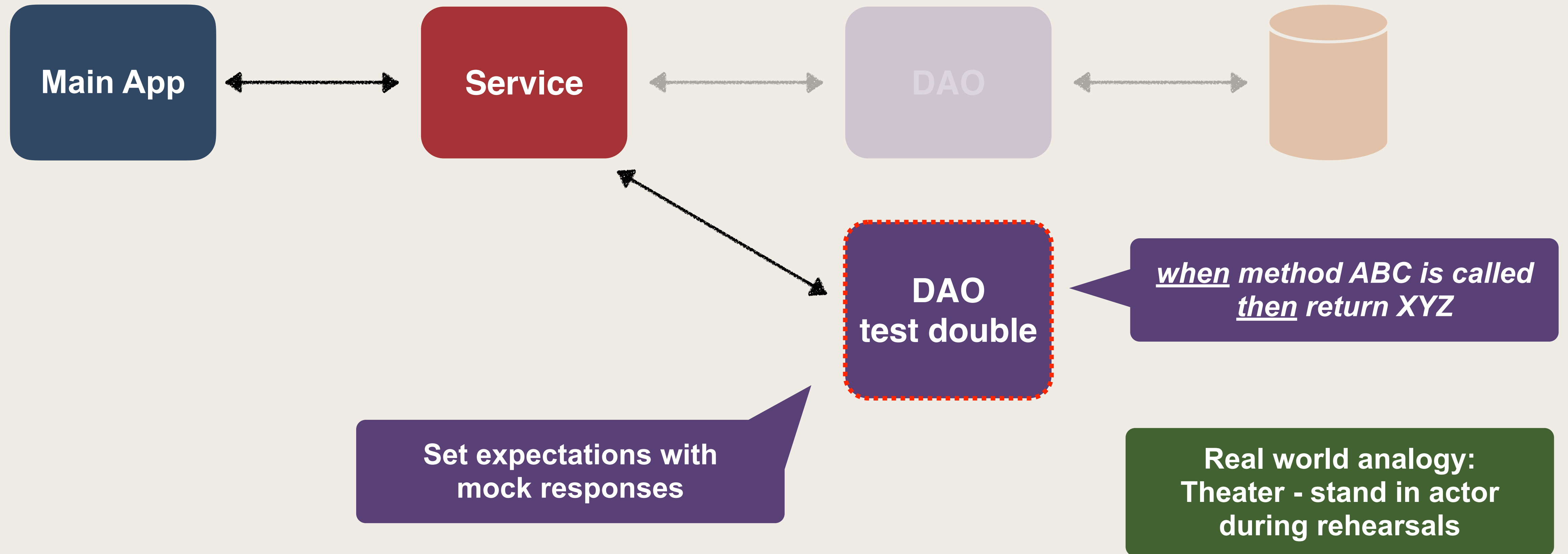
Mocks with Mockito and Spring Boot



Typical Application Architecture



Using a Test Double



**The technique of using test doubles
is known as "mocking"**

Benefits of Mocking

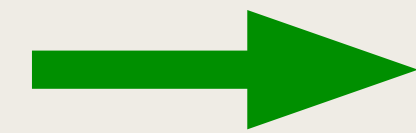
- Allows us to test a given class in isolation
- Test interaction between given class and its dependencies
- Minimizes configuration / availability of dependencies
- For example DAO, DB, REST API etc
 - We can mock the DAO to give a response
 - We can mock a REST API to give a response

**Real world analogy:
Theater - stand in actor
during rehearsals**

Mocking Frameworks

- The Java ecosystem includes a number of Mocking frameworks
- The Mocking frameworks provide following features:
 - Minimize hand-coding of mocks ... leverage annotations
 - Set expectations for mock responses
 - Verify the calls to methods including the number of calls
 - Programmatic support for throwing exceptions

Mocking Frameworks



Name	Website
Mockito	<code>site.mockito.org</code>
EasyMock	<code>www.easymock.org</code>
JMockit	<code>jmockit.github.io</code>
...	

**We will use Mockito since
Spring Boot has built-in support for Mockito**

Spring Boot Starter - Transitive Dependency for Mockito

pom.xml

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

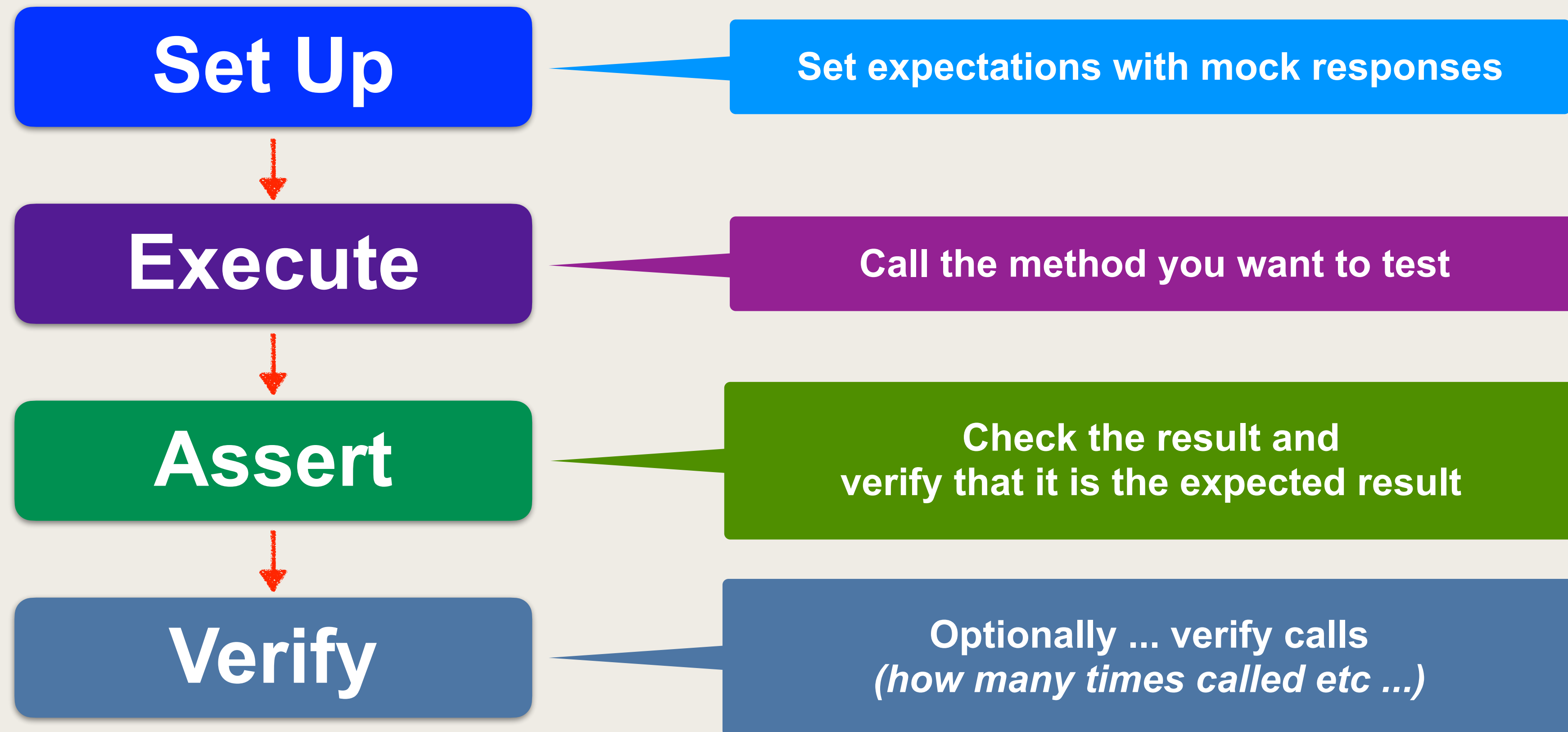
**Starter includes a transitive
dependency on Mockito**

We get it for free :-)

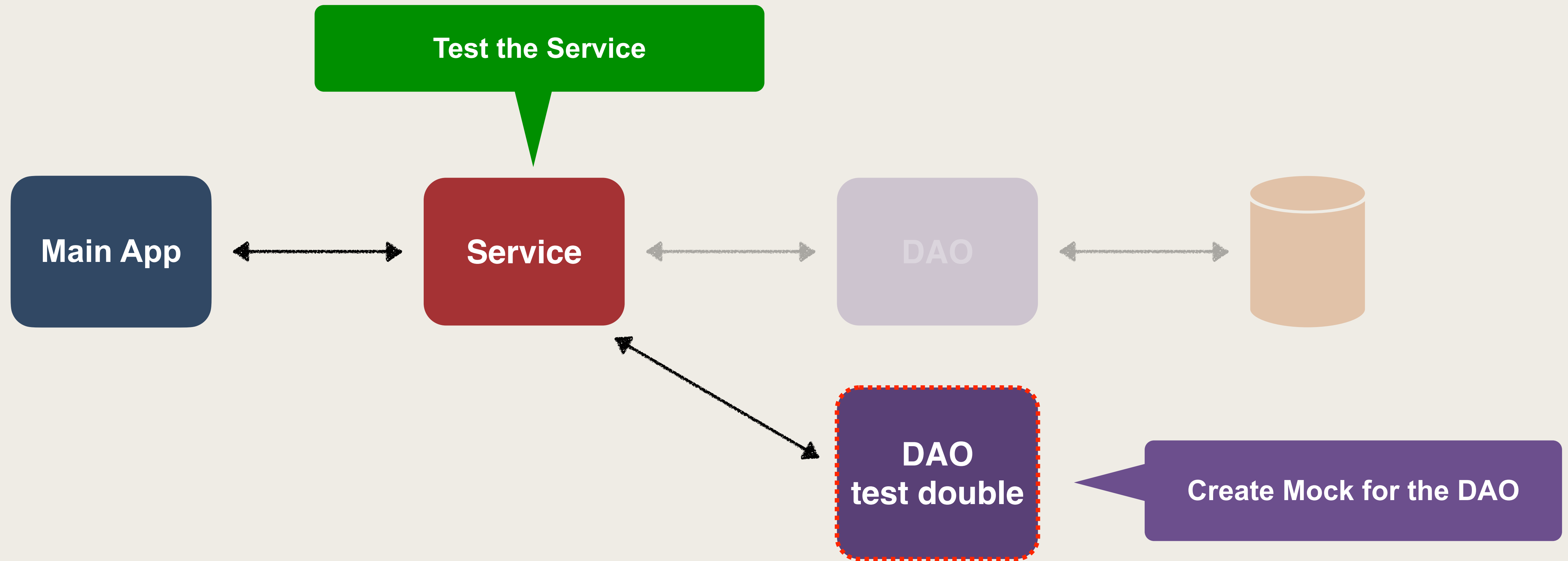
```
▼ m spring-boot-unit-testing-demo
  > Lifecycle
  > Plugins
  ▼ Dependencies
    > org.springframework.boot:spring-boot-starter:3.4.0
    ▼ org.springframework.boot:spring-boot-starter-test:3.4.0 (test)
      ▢ org.springframework.boot:spring-boot-starter:3.4.0 (test omitted for dup
      > org.springframework.boot:spring-boot-test:3.4.0 (test)
      > org.springframework.boot:spring-boot-test-autoconfigure:3.4.0 (test)
      > com.jayway.jsonpath:json-path:2.9.0 (test)
      > jakarta.xml.bind:jakarta.xml.bind-api:4.0.2 (test)
      > net.minidev:json-smart:2.5.1 (test)
      > org.assertj:assertj-core:3.26.3 (test)
      > org.awaitility:awaitility:4.2.2 (test)
      ▢ org.hamcrest:hamcrest:2.2 (test)
      > org.junit.jupiter:junit-jupiter:5.11.3 (test)
      > ▢ org.mockito:mockito-core:5.14.2 (test)
      > ▢ org.mockito:mockito-junit-jupiter:5.14.2 (test)
      > org.skyscreamer:jsonassert:1.5.3 (test)
      ▢ org.springframework:spring-core:6.2.0 (test omitted for duplicate)
      > org.springframework:spring-test:6.2.0 (test)
      > org.xmlunit:xmlunit-core:2.10.0 (test)
```


Unit testing with Mocks

- Unit tests with Mocks have the following structure



Testing Plan

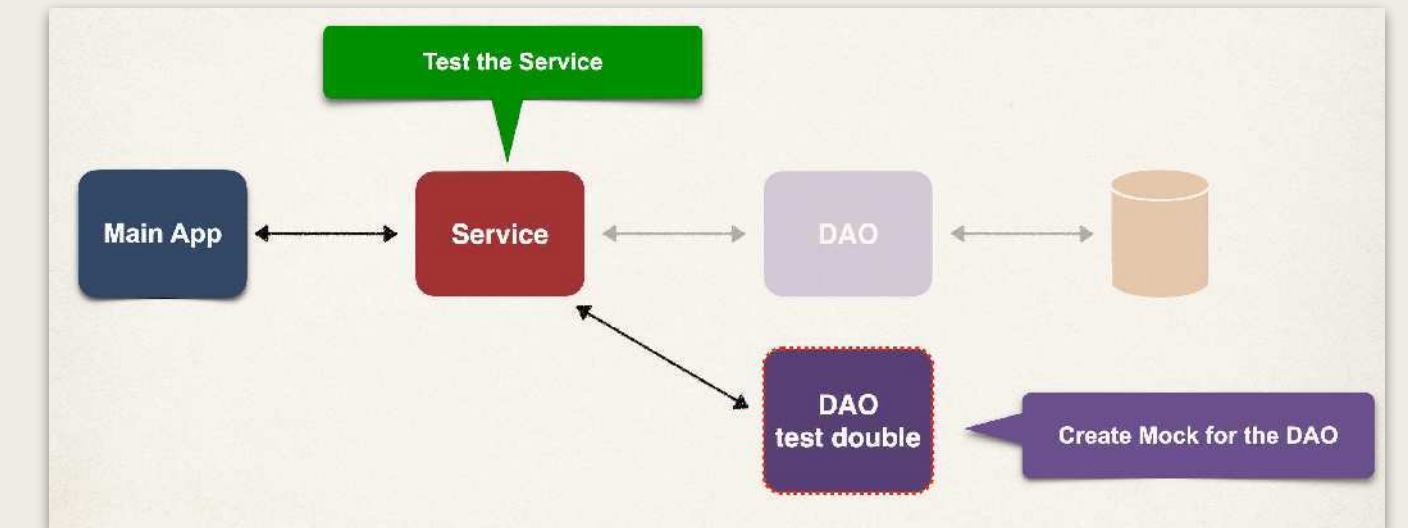


Review code for Service and DAO

ApplicationService.java

Dependency

```
public class ApplicationService {  
  
    @Autowired  
    private ApplicationDao applicationDao;  
  
    public double addGradeResultsForSingleClass(List<Double> grades) { ... }  
  
    public double findGradePointAverage (List<Double> grades ) { ... }  
  
    public Object checkNull(Object obj) { ... }  
  
}
```



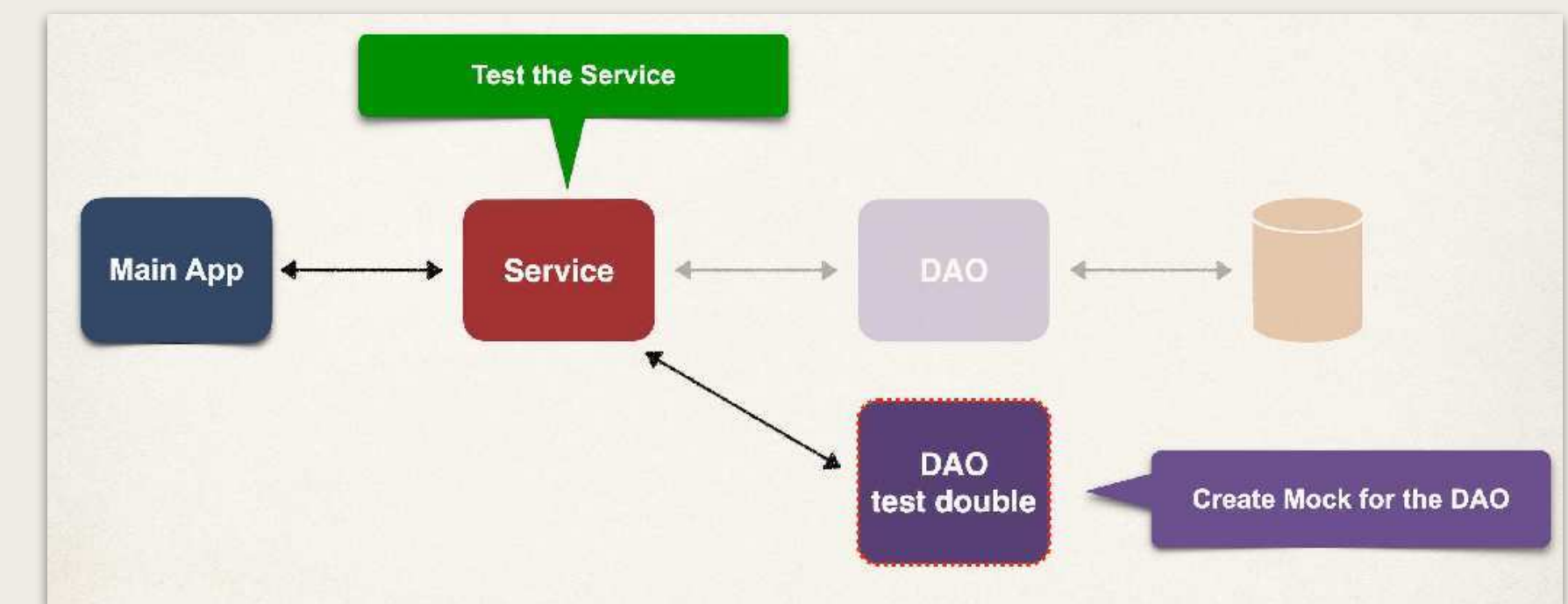
ApplicationDao.java

```
public class ApplicationDao {  
  
    public double addGradeResultsForSingleClass(List<Double> grades) { ... }  
  
    public double findGradePointAverage (List<Double> grades ) { ... }  
  
    public Object checkNull(Object obj) { ... }  
  
}
```

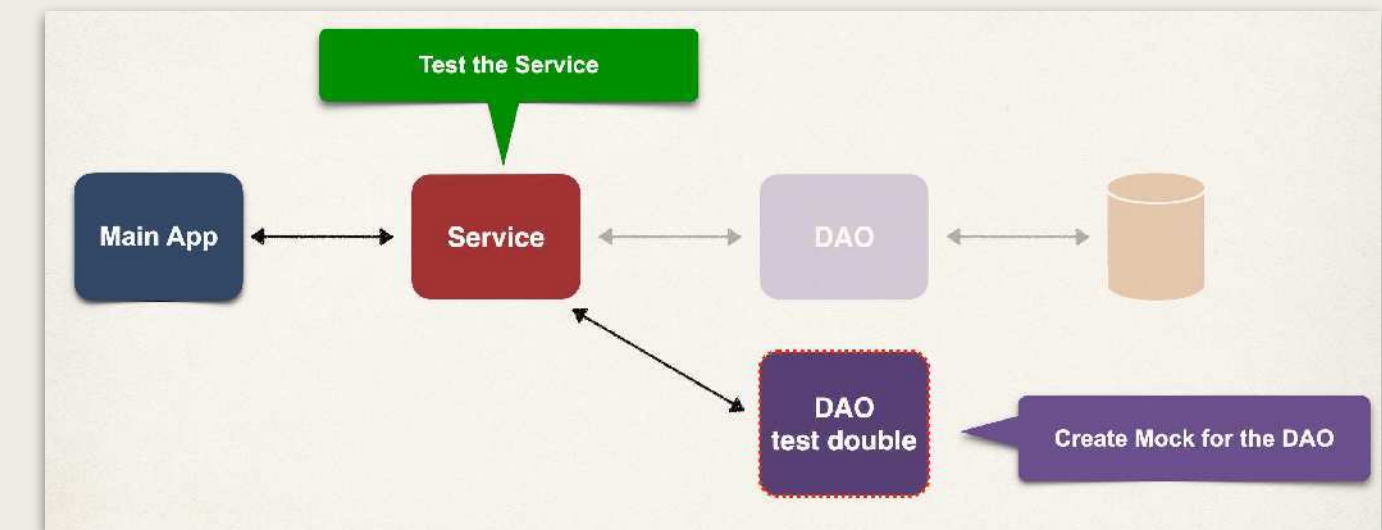

Development Process

1. Create Mock for DAO
2. Inject mock into Service
3. Set up expectations
4. Call method under test and assert results
5. Verify method calls

Step-By-Step



Step 1: Create Mock for the DAO



MockAnnotationTest.java

```
import org.mockito.Mock;
...

@SpringBootTest(classes=MvcTestingExampleApplication.class)
public class MockAnnotationTest {

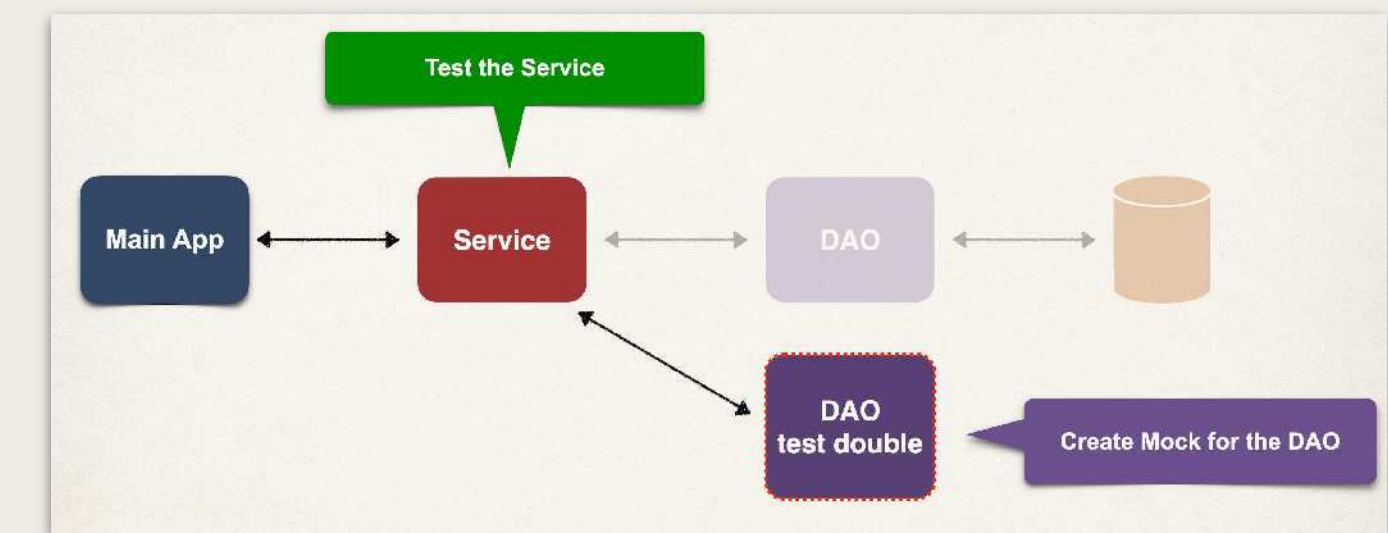
    @Mock
    private ApplicationDao applicationDao;

    ...

}
```

Create Mock for the DAO

Step 2: Inject mock into Service



MockAnnotationTest.java

```
import org.mockito.Mock;
import org.mockito.InjectMocks;
...

@SpringBootTest(classes=MvcTestingExampleApplication.class)
public class MockAnnotationTest {

    @Mock
    private ApplicationDao applicationDao;

    @InjectMocks
    private ApplicationService applicationService;

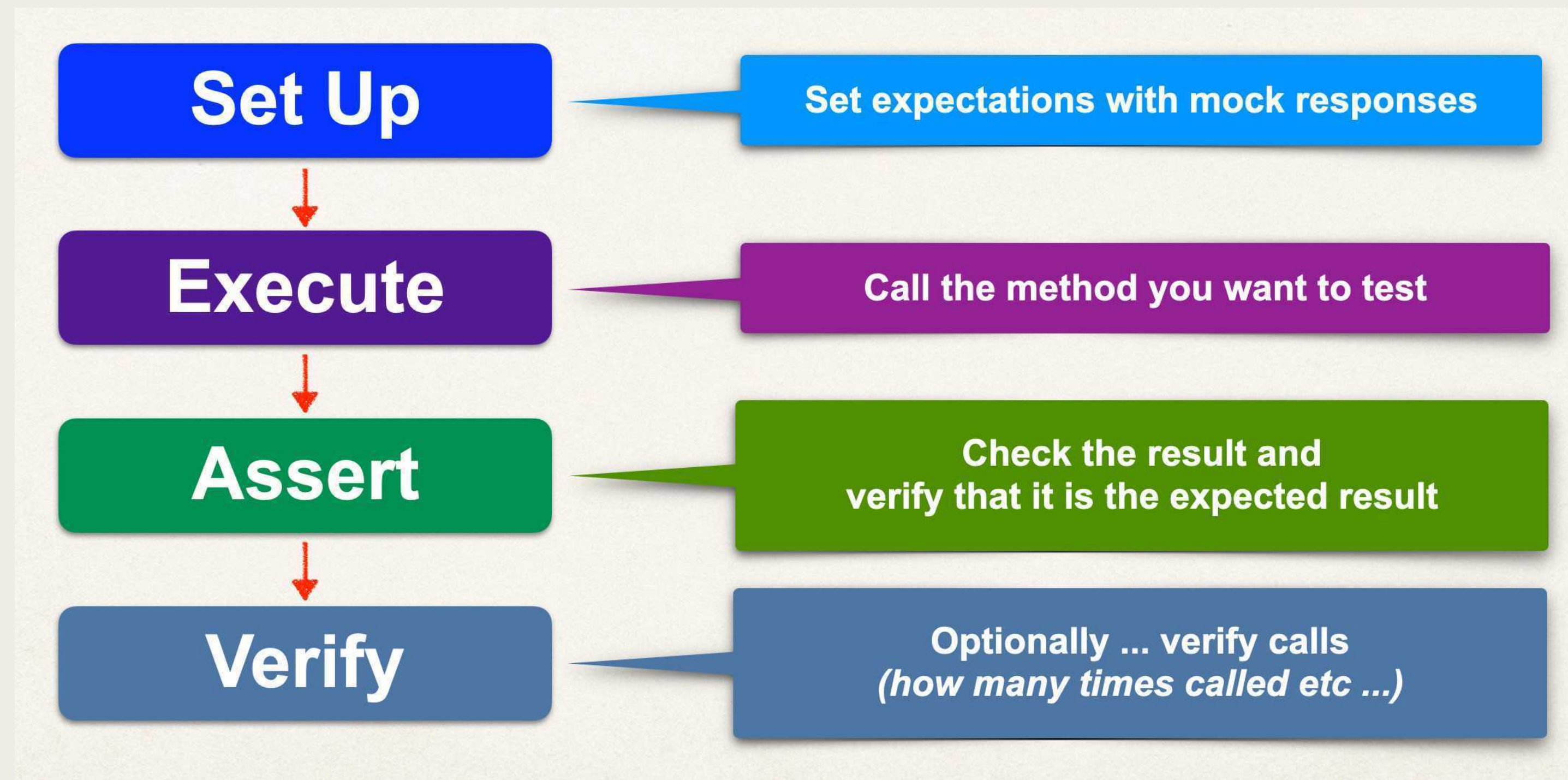
    ...

}
```

Inject mock dependencies

Note: Will only inject dependencies annotated with @Mock or @Spy

Step 3: Set up expectations



Step 3: Set up expectations

*when method
doSomeWork(...)
is called
then return "I am finished"*

```
import static org.mockito.Mockito.when;  
...  
  
String aResponse = "I am finished";  
  
when( doSomeWork( ) ).thenReturn( aResponse );
```

response

method

Real world analogy:
Theater - just read the script

Step 3: Set up expectations

MockAnnotationTest.java

```
import static org.mockito.Mockito.when;
import static org.junit.jupiter.api.Assertions.assertEquals;
...

@SpringBootTest(classes=MvcTestingExampleApplication.class)
public class MockAnnotationTest {

    @Mock
    private ApplicationDao applicationDao;

    @InjectMocks
    private ApplicationService applicationService;

    @Autowired
    private CollegeStudent studentOne;

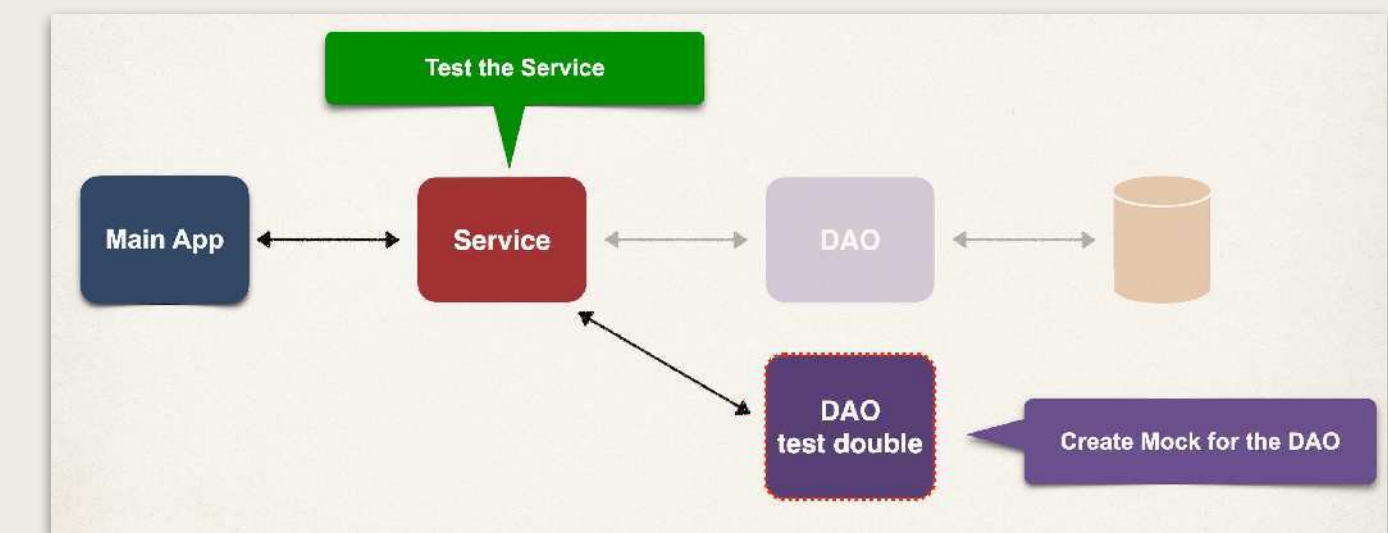
    @Autowired
    private StudentGrades studentGrades;

    @DisplayName("When & Verify")
    @Test
    public void assertEqualsTestAddGrades() {
        when(applicationDao.addGradeResultsForSingleClass(
            studentGrades.getMathGradeResults())) .thenReturn(100.0);

        ...
    }
}
```

Set up expectations
for mock response

when method
addGradeResultsForSingleClass(...)
is called
then return 100.0



Step 4: Call method under test and assert results

MockAnnotationTest.java

```
import static org.mockito.Mockito.when;
import static org.junit.jupiter.api.Assertions.assertEquals;
...

@SpringBootTest(classes= MvcTestingExampleApplication.class)
public class MockAnnotationTest {

    @Mock
    private ApplicationDao applicationDao;

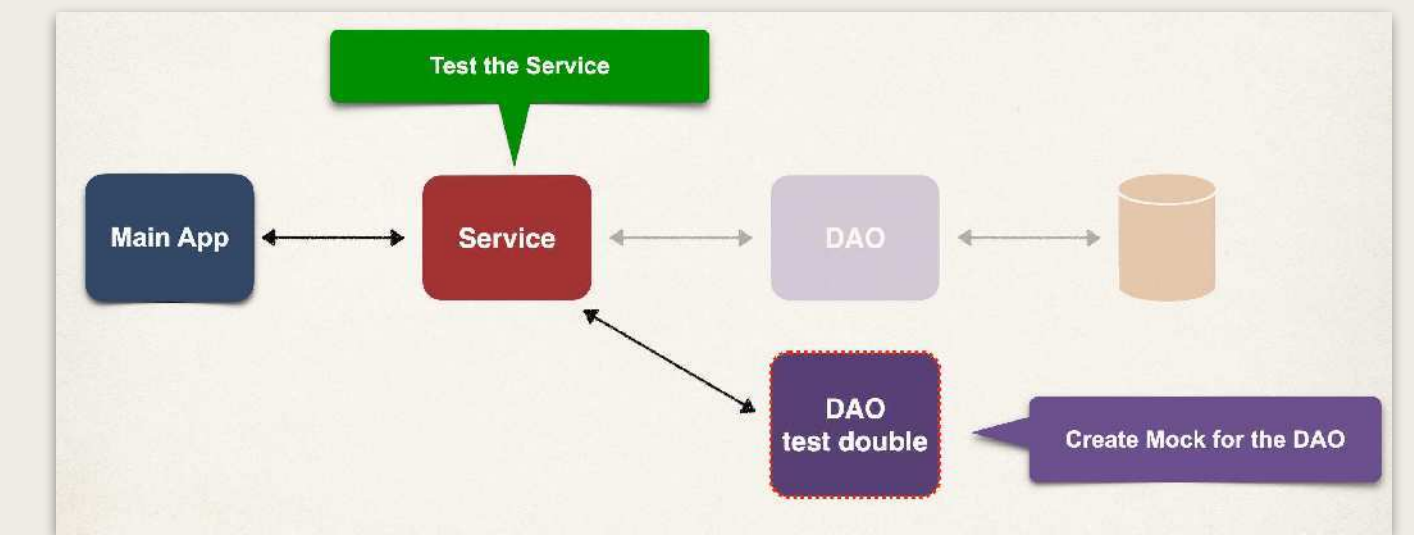
    @InjectMocks
    private ApplicationService applicationService;

    @Autowired
    private CollegeStudent studentOne;

    @Autowired
    private StudentGrades studentGrades;

    @DisplayName("When & Verify")
    @Test
    public void assertEqualsTestAddGrades() {
        when(applicationDao.addGradeResultsForSingleClass(
            studentGrades.getMathGradeResults())).thenReturn(100.0);

        assertEquals(100.0, applicationService.addGradeResultsForSingleClass(
            studentOne.getStudentGrades().getMathGradeResults()));
    }
}
```



Assert results

*The service uses the DAO ...
that has been set up to return 100.0*

Step 5: Verify method calls

MockAnnotationTest.java

```
import static org.mockito.Mockito.when;
import static org.mockito.Mockito.verify;
import static org.mockito.Mockito.times;
...

@SpringBootTest(classes= MvcTestingExampleApplication.class)
public class MockAnnotationTest {

    @Mock
    private ApplicationDao applicationDao;

    @InjectMocks
    private ApplicationService applicationService;

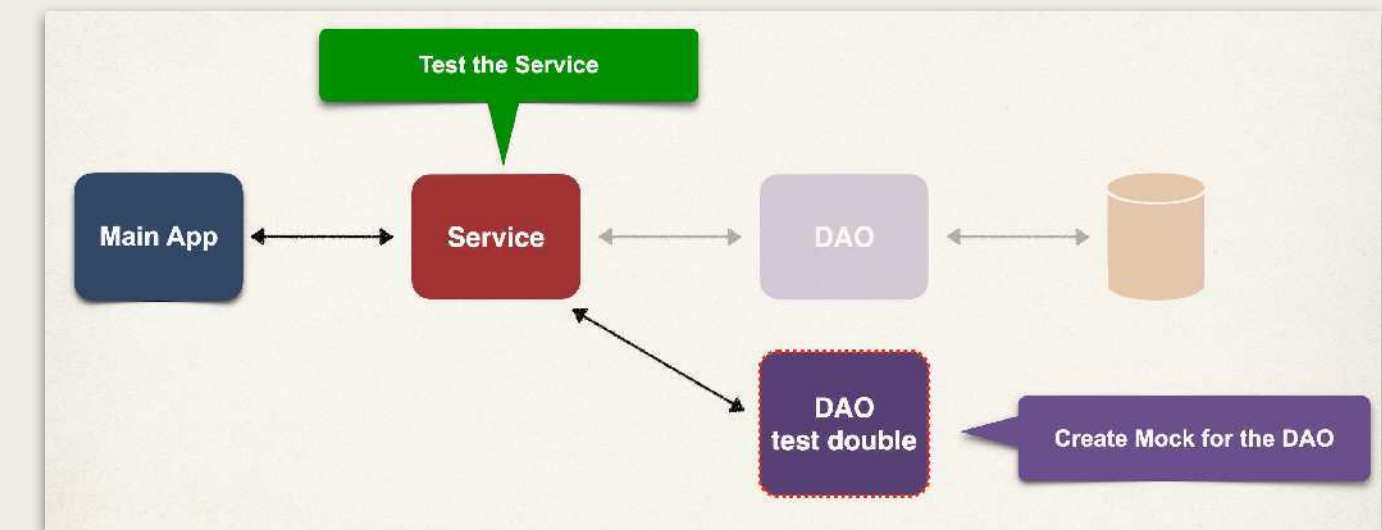
    ...

    @DisplayName("When & Verify")
    @Test
    public void assertEqualsTestAddGrades() {
        when(applicationDao.addGradeResultsForSingleClass(
            studentGrades.getMathGradeResults()))
            .thenReturn(100.0);

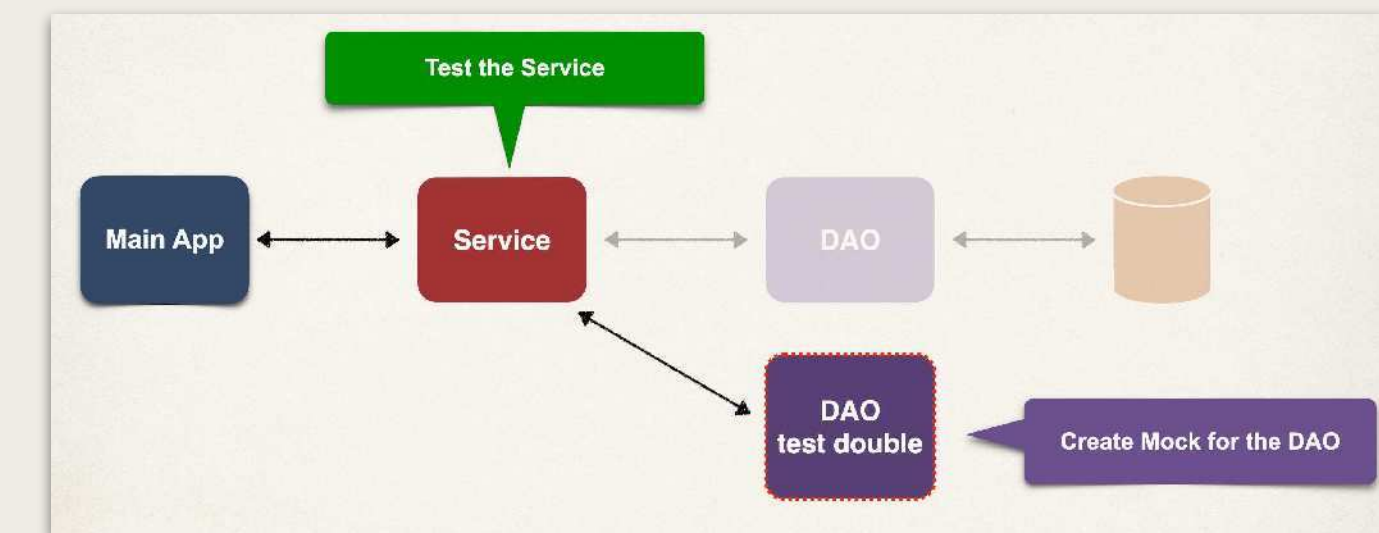
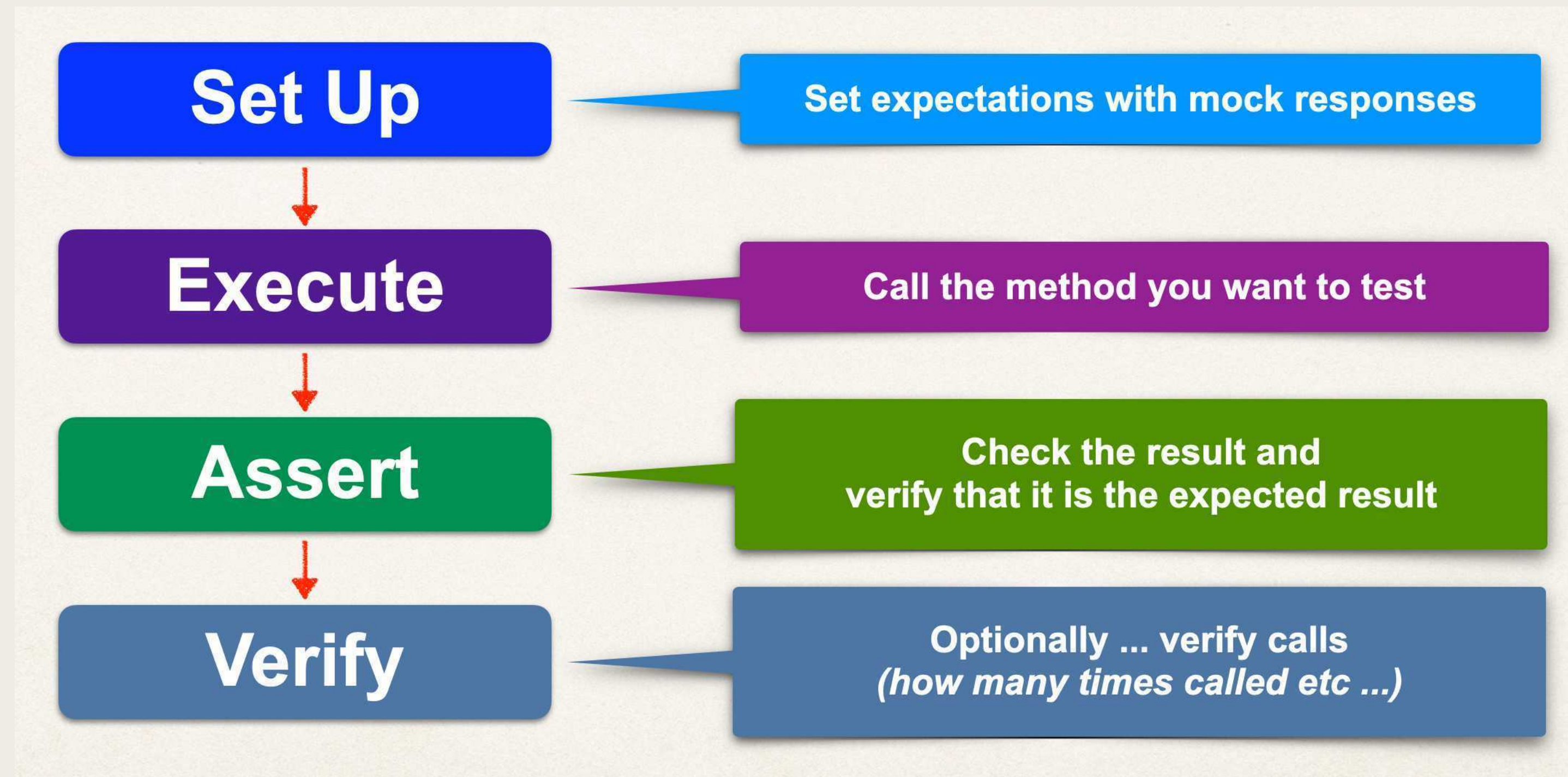
        assertEquals(100.0, applicationService.addGradeResultsForSingleClass(
            studentOne.getStudentGrades().getMathGradeResults()));

        verify(applicationDao,
            times(1)).addGradeResultsForSingleClass(studentGrades.getMathGradeResults());
    }
}
```

Verify the DAO method
was called 1 time



Recap



Mockito Resources

- Additional features
 - Stubs, spies
 - Argument matchers, Answers
 - ...

site.mockito.org

Spring Boot @MockitoBean



MockAnnotationTest.java

```
import org.mockito.Mock;
import org.mockito.InjectMocks;
...

@SpringBootTest(classes=MvcTestingExampleApplication.class)
public class MockAnnotationTest {

    @Mock
    private ApplicationDao applicationDao;

    @InjectMocks
    private ApplicationService applicationService;

    ...

}
```

Inject mock dependencies

Note: Will only inject dependencies annotated with @Mock or @Spy

Spring Boot @MockitoBean

- Instead of using Mockito: @Mock and @InjectMocks
- Use Spring Boot support: @MockitoBean and @Autowired
- @MockitoBean
 - includes Mockito @Mock functionality
 - also adds mock bean to Spring ApplicationContext
 - if existing bean is there, the mock bean will replace it
 - thus making the mock bean available for injection with @Autowired

**Use Spring Boot @MockitoBean
when you need to inject mocks
AND
inject regular beans from app context**

BEFORE

MockAnnotationTest.java

```
import org.mockito.Mock;
import org.mockito.InjectMocks;
...

@SpringBootTest(classes=MvcTestingExampleApplication.class)
public class MockAnnotationTest {

    @Mock
    private ApplicationDao applicationDao;

    @InjectMocks
    private ApplicationService applicationService;

    ...
}
```

AFTER

MockAnnotationTest.java

```
import org.springframework.boot.test.context.bean.override.mockito.MockitoBean;
import org.springframework.beans.factory.annotation.Autowired;
...

@SpringBootTest(classes=MvcTestingExampleApplication.class)
public class MockAnnotationTest {

    @MockitoBean
    private ApplicationDao applicationDao;

    @Autowired
    private ApplicationService applicationService;

    ...
}
```

Create Mock for the DAO

Inject dependencies

No longer a limitation ...
can inject any dependency ...
mock or regular bean

Throwing Exceptions with Mocks



Throwing Exceptions

- May need to configure the mock to throw an exception
- Possible use case
 - Testing how the code handles exceptions

Refresher

MockAnnotationTest.java

```
...  
  
@SpringBootTest(classes=MvcTestingExampleApplication.class)  
public class MockAnnotationTest {  
  
    @MockitoBean  
    private ApplicationDao applicationDao;  
  
    @Autowired  
    private ApplicationService applicationService;  
  
    ...  
  
}
```

We will mock the DAO to throw exceptions

Throw Exception

MockAnnotationTest.java

```
@DisplayName("Thrown an Exception")
@Test
public void throwAnException() {
    CollegeStudent nullStudent = (CollegeStudent) context.getBean("collegeStudent");

    when(applicationDao.checkNotNull(nullStudent))
        .thenReturn(new RuntimeException());

    assertThrows(RuntimeException.class, () -> {
        applicationService.checkNotNull(nullStudent);
    });
}
```

When the checkNull(...) method is called ...
thenReturn an exception

Assert that the exception was thrown

Throw Exception: Consecutive calls

MockAnnotationTest.java

```
@DisplayName("Multiple Stubbing")
@Test
public void stubbingConsecutiveCalls() {
    CollegeStudent nullStudent = (CollegeStudent) context.getBean("collegeStudent");

    when(applicationDao.checkNotNull(nullStudent))
        .thenThrow(new RuntimeException())
        .thenReturn("Do not throw exception second time");

    assertThrows(RuntimeException.class, () -> {
        applicationService.checkNotNull(nullStudent);
    });

    assertEquals("Do not throw exception second time", applicationService.checkNotNull(nullStudent));
}
```

First call

First call ... throw exception

Consecutive calls ... do NOT throw exception
Just return a string

Second call