Demystify
Instant
Destroy target enchantment.
Behind every mage is a trail of shattered lies.
Véronique Meignaud
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# Testing Spring Boot Applications Demystified

## Full-Day Workshop

*DATEV Coding Festival 09.10.2025*

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## Discuss Exercises from Lab 3

## Lab 4

## Best Practices, Pitfalls, AI & Outlook

## Last Lab

### Spring Boot Testing Best Practices & Pitfalls

## Best Practice 1: Test Parallelization

**Goal**: Reduce build time and get faster feedback

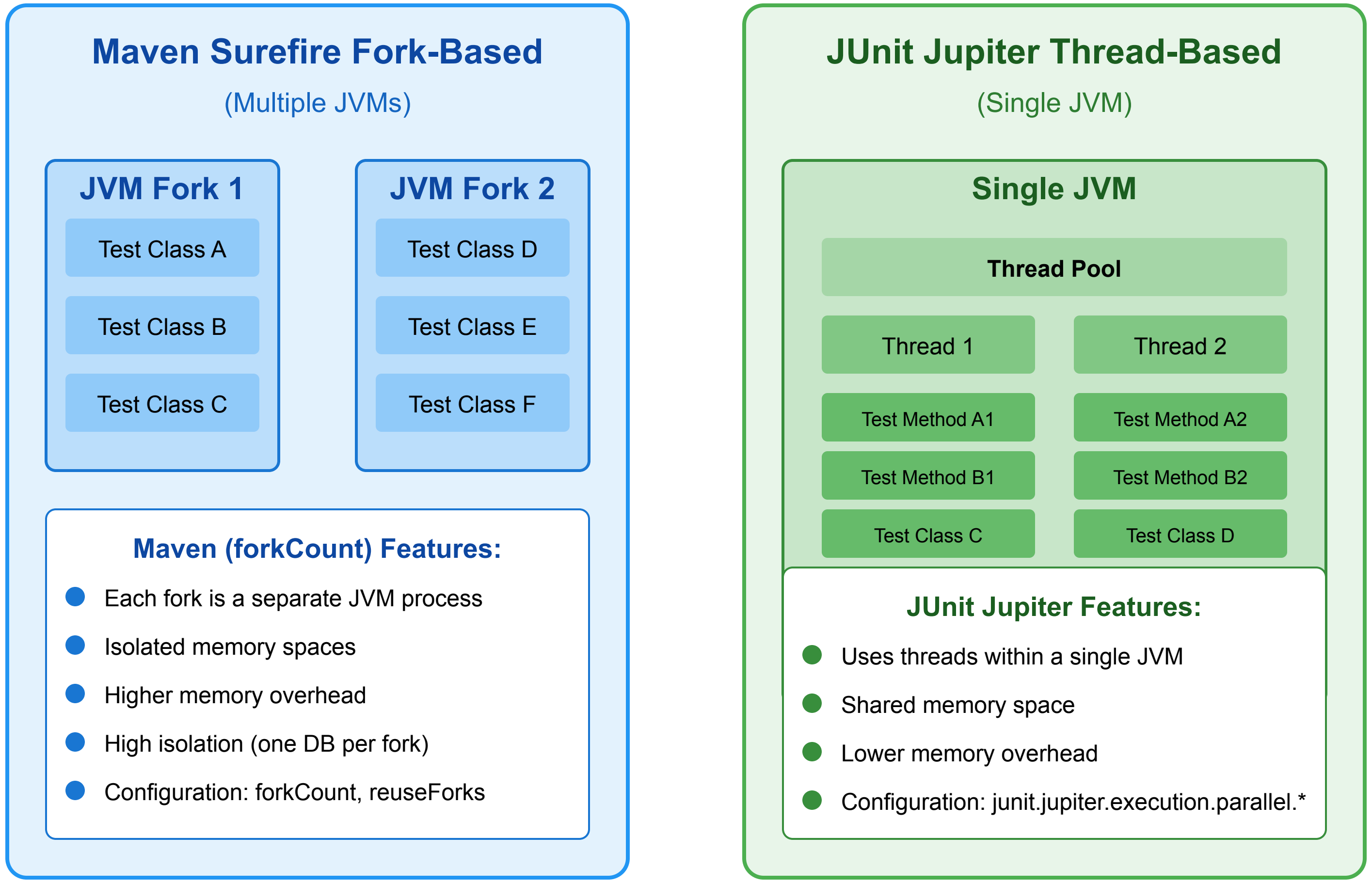
Requirements:

- No shared state
- No dependency between tests and their execution order
- No mutation of global state

Two ways to achieve this:

- Fork a new JVM with Surefire/Failsafe and let it run in parallel -> more resources but isolated execution
- Use JUnit Jupiter's parallelization mode and let it run in the same JVM with multiple threads

## Java Test Parallelization Options



**Maven (forkCount) Features:**

- Each fork is a separate JVM process
- Isolated memory spaces
- Higher memory overhead
- High isolation (one DB per fork)
- Configuration: forkCount, reuseForks

**JUnit Jupiter Features:**

- Uses threads within a single JVM
- Shared memory space
- Lower memory overhead
- Configuration: junit.jupiter.execution.parallel.*

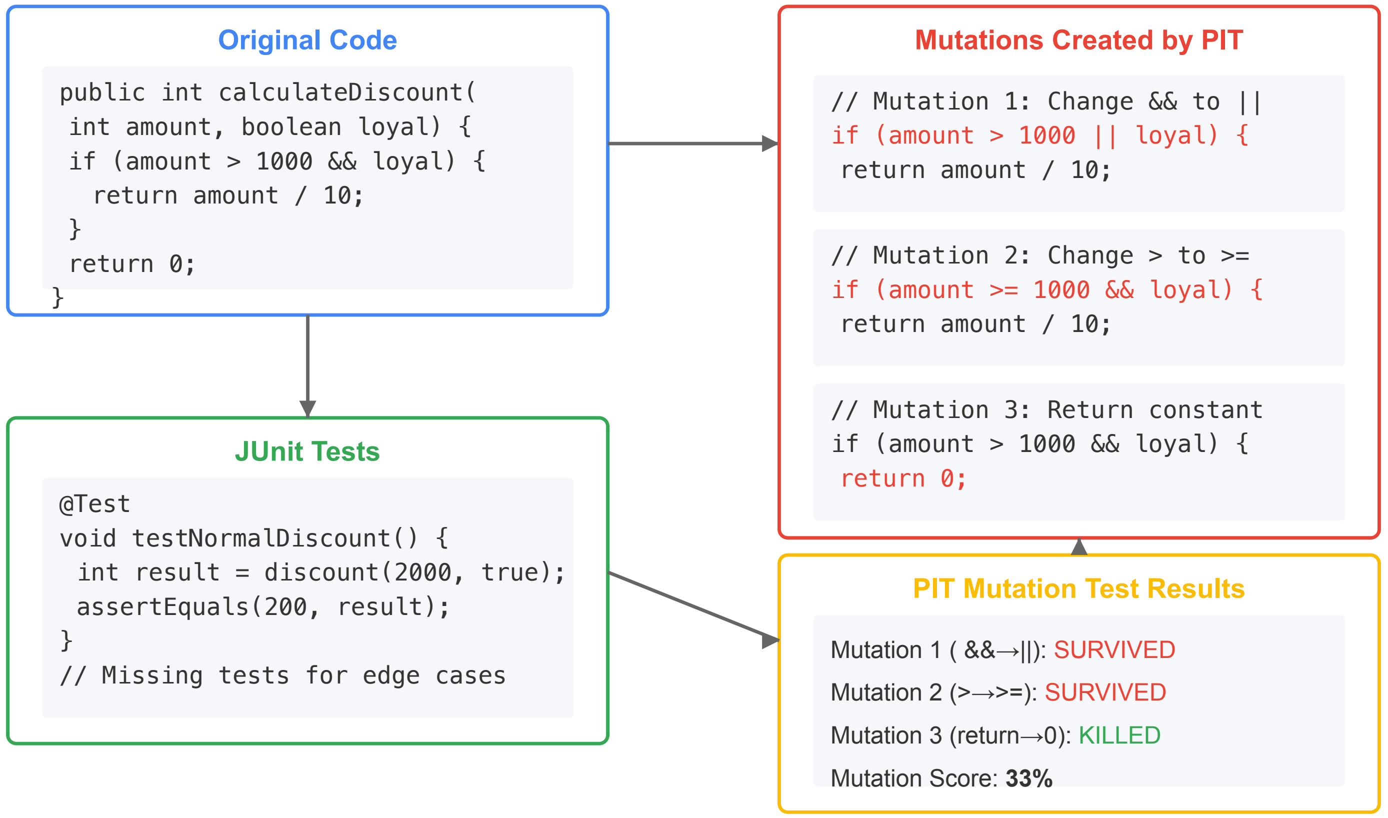
## Best Practice 2: Get Help from AI

- Diffblue Cover: #1 AI Agent for unit testing complex Java code at scale
- Agent vs. Assistant
- LLMs: ChatGPT, Claude, Gemini, etc.
- Claude Code
- TDD with an LLM?
- (Not AI but still useful) OpenRewrite for migrations
- Clearly define your requirements in e.g. `claude.md` or cursor rule files

## Best Practice 3: Try Mutation Testing

- Having high code coverage might give you a **false sense of security**
- Mutation Testing with PIT
- Beyond Line Coverage: Traditional tools like JaCoCo show which code runs during tests, but PIT verifies if your tests actually detect when code behaves incorrectly by introducing "**mutations**" to your source code.
- Quality Guarantee: PIT automatically modifies your code (changing conditionals, return values, etc.) to ensure your tests fail when they should, **revealing blind spots** in seemingly comprehensive test suites.
- Considerations for bigger projects: only run on the new code diffs, not on the whole codebase

## PIT Mutation Testing Example



**Original Code**

```
public int calculateDiscount(
 int amount, boolean loyal) {
 if (amount > 1000 && loyal) {
   return amount / 10;
 }
 return 0;
}
```

**JUnit Tests**

```
@Test
void testNormalDiscount() {
 int result = discount(2000, true);
 assertEquals(200, result);
}
// Missing tests for edge cases
```

**Mutations Created by PIT**

```
// Mutation 1: Change && to ||
if (amount > 1000 || loyal) {
 return amount / 10;
```

```
// Mutation 2: Change > to >=
if (amount >= 1000 && loyal) {
 return amount / 10;
```

```
// Mutation 3: Return constant
if (amount > 1000 && loyal) {
 return 0;
```

**PIT Mutation Test Results**

Mutation 1 ( &&→||): SURVIVED

Mutation 2 (>→>=): SURVIVED

Mutation 3 (return→0): KILLED

Mutation Score: **33%**

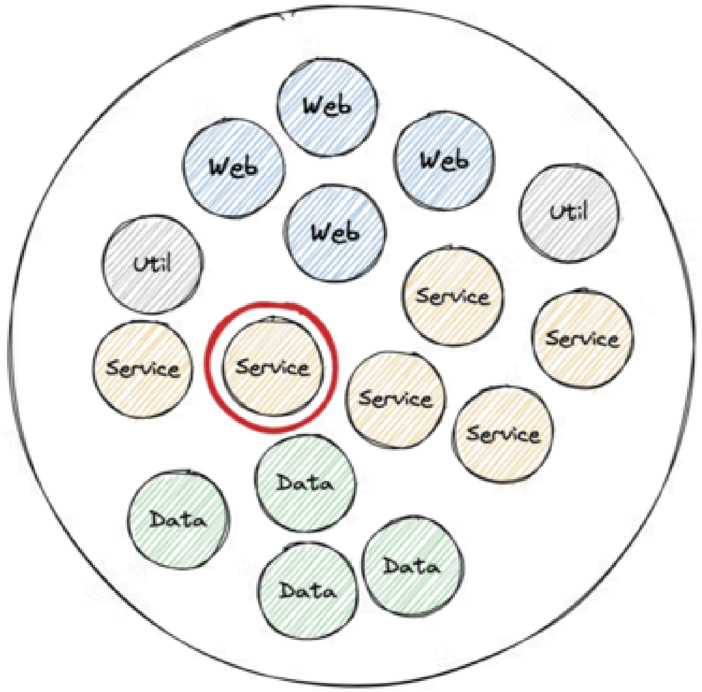
Action Required: Add tests for boundary cases (1000, loyal) and different combinations of inputs

## Common Spring Boot Testing Pitfalls to Avoid

## Testing Pitfall 1: `@SpringBootTest` Obsession

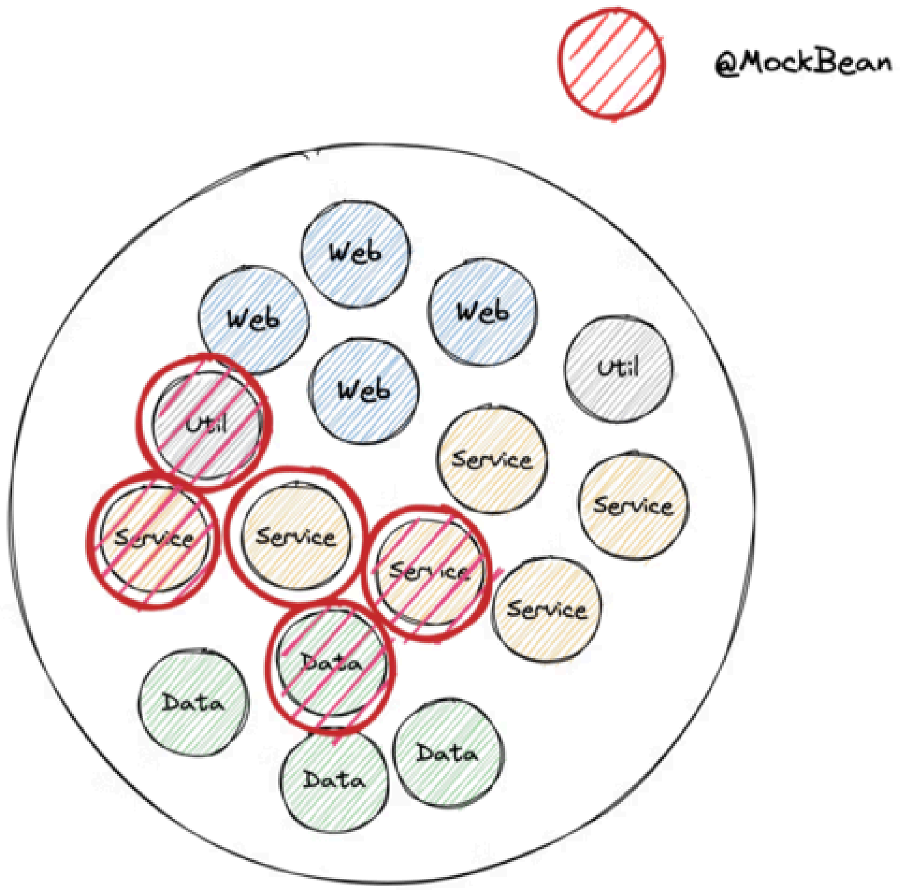
- The name could apply it's a one size fits all solution, but it isn't
- It comes with costs: starting the (entire) application context
- Useful for integration tests that verify the whole application but not for testing a single service in isolation
- Start with unit tests, see if sliced tests are applicable and only then use `@SpringBootTest`

## @SpringBootTest Obsession Visualized



Testing every single class with @SpringBootTest

... results in a lot of different context setups and slows down the build



## Testing Pitfall 2: @MockitoBean vs. @MockBean vs. @Mock

- `@MockBean` is a Spring Boot specific annotation that replaces a bean in the application context with a Mockito mock
- `@MockBean` is deprecated in favor of the new `@MockitoBean` annotation
- `@Mock` is a Mockito annotation, only for unit tests

## Testing Pitfall 3: JUnit 4 vs. JUnit 5

- You can mix both versions in the same project but not in the same test class
- Browsing through the internet (aka. StackOverflow/blogs/LLMs) for solutions, you might find test setups that are still for JUnit 4
- Easily import the wrong `@Test` and you end up wasting one hour because the Spring context does not work as expected

| JUnit 4 | JUnit 5 |
|---|---|
| @Test from org.junit | @Test from org.junit.jupiter.api |
| @RunWith | @ExtendWith/@RegisterExtension |
| @ClassRule/@Rule | - |
| @Before | @BeforeEach |
| @Ignore | @Disabled |
| @Category | @Tag |

## Summary Lab 1

- Spring Boot applications come with batteries-included for testing
- Testing Swiss-Army Knife pulls many test libraries
- Master JUnit, Mockito and AssertJ first
- Maven Failsafe and Maven Surefire Plugin run our tests (Gradle equivalent `test` task)
- Explore the JUnit Jupiter Extension Model for cross-cutting test concerns

## Summary Lab 2

- Sliced testing helps to verify parts of your application in isolation
- `@WebMvcTest`: Verify our controller when it comes to validation, authentication, authorization, serialization, exception mapping, etc.
- `@DataJpaTest`: Test our JPA-related code with a real database
- Testcontainers: Seamlessly start external infrastructure components locally

## Summary Lab 3

- Things might get complicated when trying to launch the entire application context
- WireMock helps to stub remote HTTP services
- The context caching feature can drastically reduce build times
- Consider the caching key structure when writing your integration tests for maximum reuse

## Summary Lab 4

- Test parallelization can help reduce build times even further
- Don't use `@SpringBootTest` everytime
- `@MockitoBean` vs. `@MockBean` vs. `@Mock`
- Consider the JUnit 4 vs. 5 pitfall
- AI can help you write your tests
- Give mutation testing a try

## What We Couldn't Touch Today

- E2E
- Tests involving the UI
- TDD (Test-Driven Development)
- BDD (Behaviour-Driven Development)
- Contract Testing
- The entire rich & mature Java testing ecosystem
- Testing reactive Spring Boot Applications

## Further Resources on Testing

- Online Course: Testing Spring Boot Applications Masterclass (on-demand, 12 hours, 130+ modules)
- eBook: 30 Testing Tools and Libraries Every Java Developer Must Know
- eBook: Stratospheric - From Zero to Production with AWS
- Further Spring Boot testing workshops (in-house/remote/hybrid)
- Consulting offerings, e.g. the Test Maturity Assessment

TESTING SPRING BOOT APPLICATIONS DEMYSTIFIED
30 TESTING TOOLS & LIBRARIES
Every Java Developer Must Know
STRATOSPHERIC
From Zero to Production with Spring Boot and AWS
BJÖRN WILMSMANN, PHILIP RIECKS, AND TOM HOMBERGS

Spring Boot Testing Fundamentals
Testing Best Practices
Explore Different Testing Strategies
Unit Testing with Mockito & JUnit
Test Different Parts of Your Application in Isolation
Master Different Spring Boot Test Slice Annotations
CERTIFICATE
of Completion
Philip Rieckx

## Time for Q&A

## Next Steps

- Request your certificate of completion via mail/LinkedIn
- Share your feedback, e.g. you could share three highlights and three areas for improvement
- Joyful testing!

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