JUNIT 5

Making your test suite more robust with JUNIT 5

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About me

- Consultant at Manifest Solutions
- Writer of Unit Tests
- Aspiring software developer

What will we cover?

- Overview of JUnit 5/Jupiter
- New testing features of JUnit 5
- Better test structuring with JUnit 5 features
- JUnit 5 extensions
- Migration from legacy test suites

Why should I upgrade?

JUnit 4 works just fine!

JUnit 5 is basically an entire rewrite, isn't that risky?

- Takes advantage of Java 8 (lambdas!)
- Features to allow for better test structuring
- Some of the annotations are named more clearly
- We're developers, we like using new technologies
- Its only test code!

Requirements

- Java 8 or greater
- JUnit 5
- Desire to write better tests
- *IDE with support for JUnit 5

*At the time of writing this, IntelliJ v 2016.x.x was not working consistently with JUnit 5

*As of July 4, 2017 IntelliJ is not supporting the most recent JUnit5 release and some hoops need to be jumped through to run tests in the IDE

JUnit 5

The new major version of the programmer-friendly testing framework for Java 8

http://junit.org/junit5/

JUnit 5 includes several sub-projects

JUnit Platform (`org.junit.platform`)
JUnit Jupiter (`org.junit.jupiter`)
JUnit Vintage (`org.junit.vintage`)

A note on philosophy…

JUnit

Annotations

@Test

@RepeatedTest

@TestFactory

@DisplayName

@BeforeEach

@AfterEach

@BeforeAll

@AfterAll

@Nested

@Tag

@Disabled

@ExtendWith

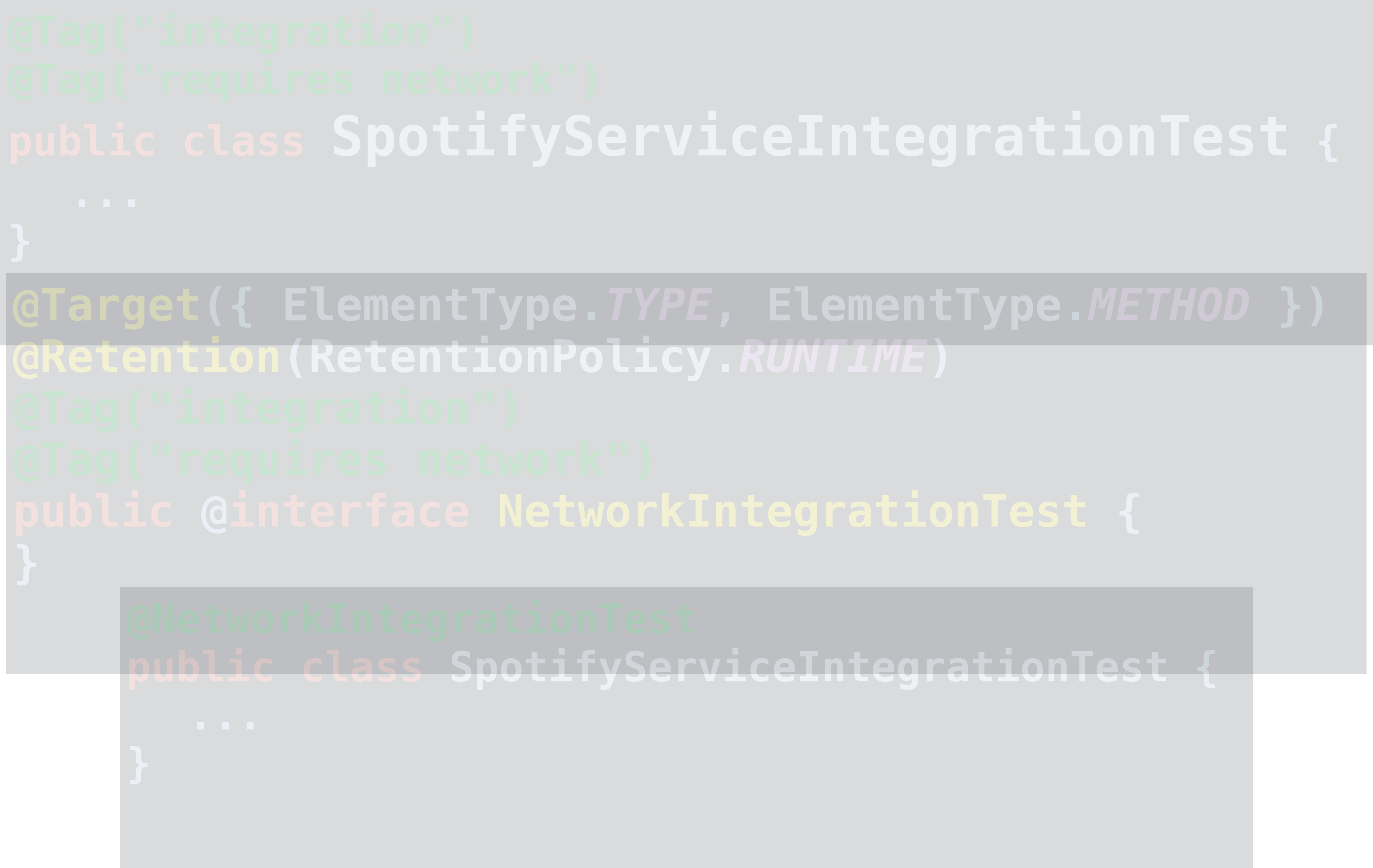
Stops [illegible] method.

[illegible]

An[illegible] JUnit 4.

JUnit 5

Meta-annotations

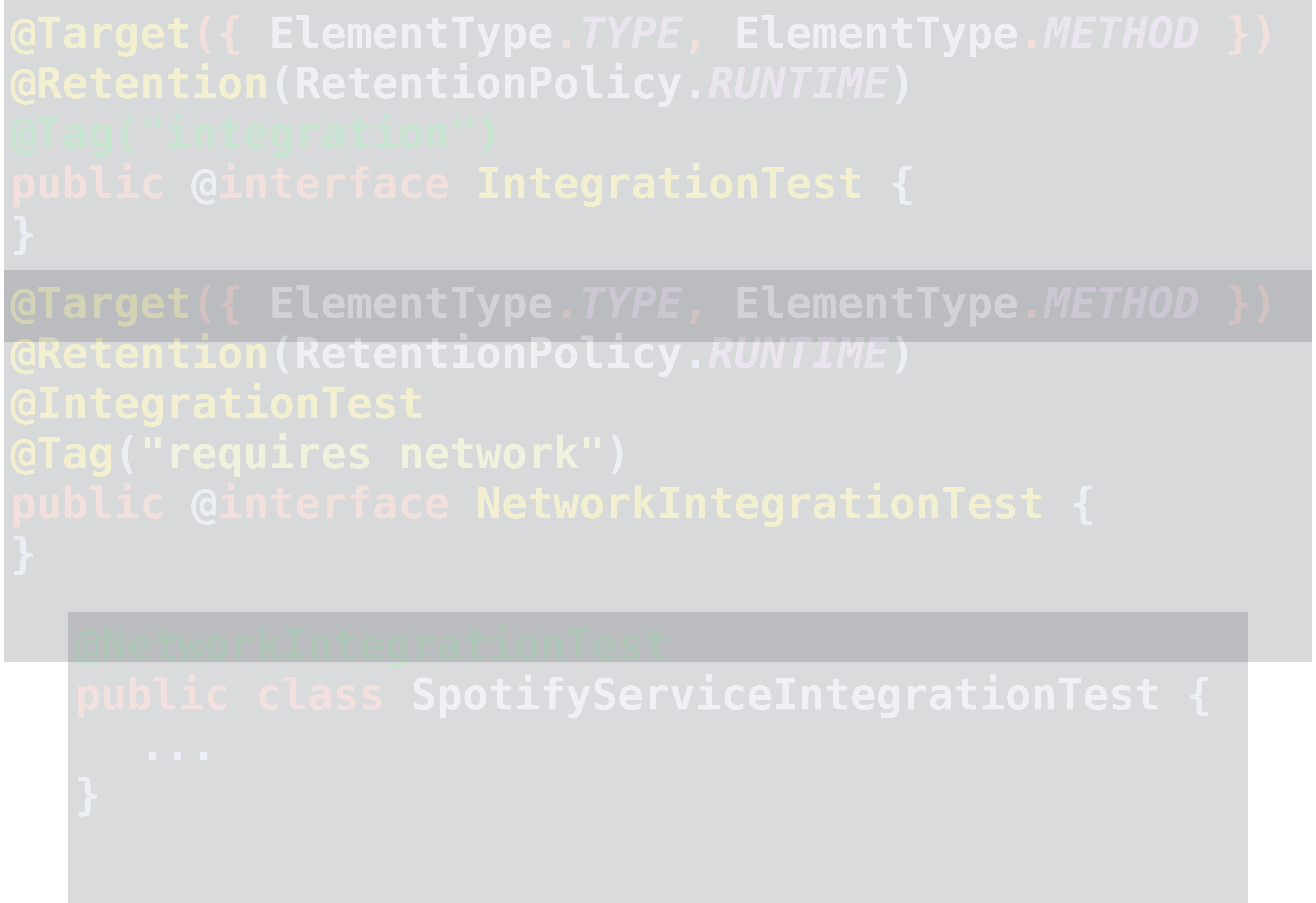


```java
@Tag("integration")
@Tag("requires network")
public class SpotifyServiceIntegrationTest {
   ...
}
```

```java
@Target({ ElementType.TYPE, ElementType.METHOD })
@Retention(RetentionPolicy.RUNTIME)
@Tag("integration")
@Tag("requires network")
public @interface NetworkIntegrationTest {
}
```

```java
@NetworkIntegrationTest
public class SpotifyServiceIntegrationTest {
   ...
}
```

Meta-annotations

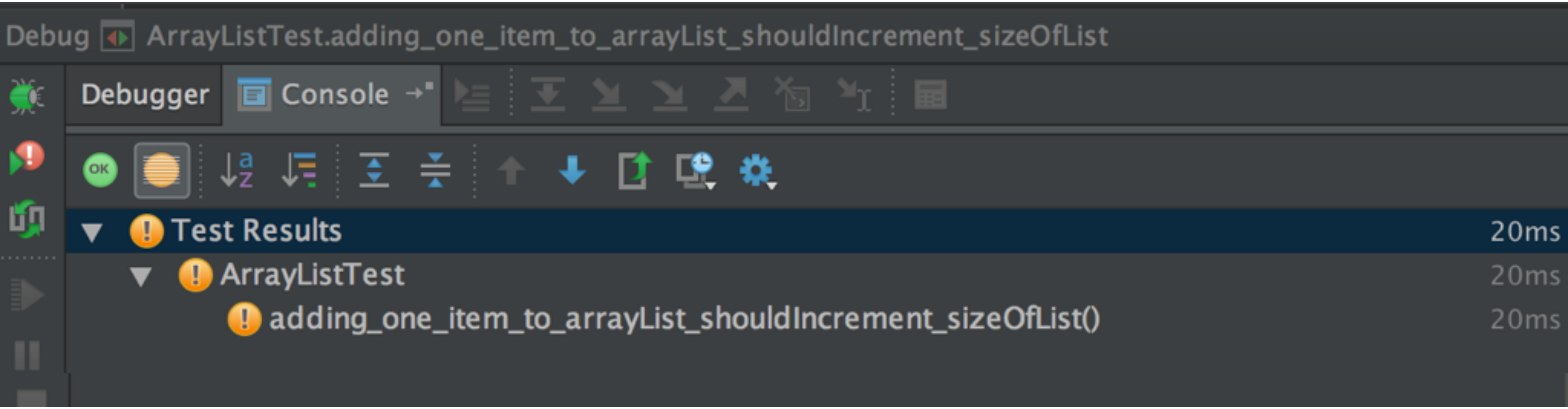


```
@Target({ ElementType.TYPE, ElementType.METHOD })
@Retention(RetentionPolicy.RUNTIME)
@Tag("integration")
public @interface IntegrationTest {
}
```

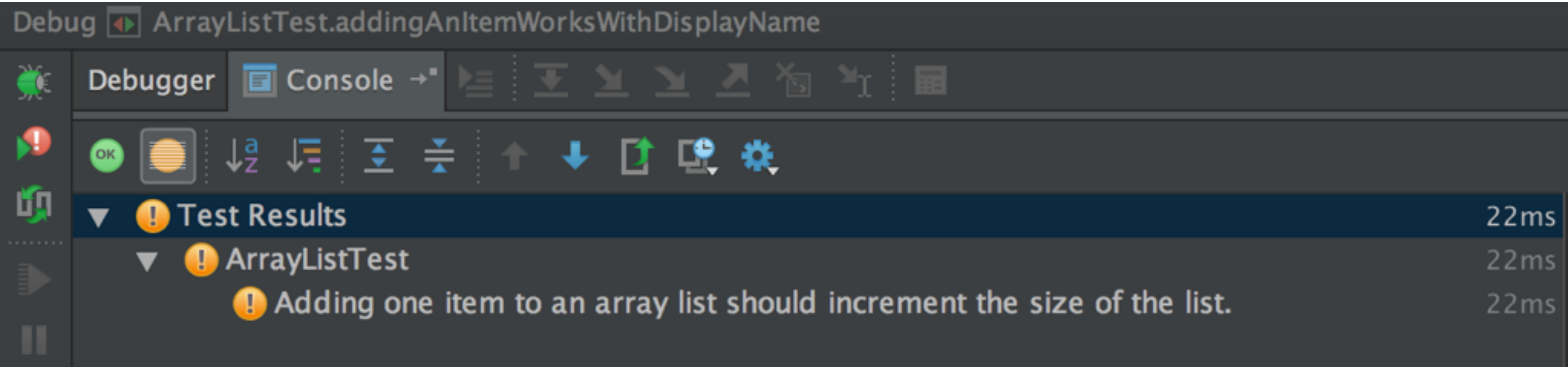
```
@Target({ ElementType.TYPE, ElementType.METHOD })
@Retention(RetentionPolicy.RUNTIME)
@IntegrationTest
@Tag("requires network")
public @interface NetworkIntegrationTest {
}
```

```
@NetworkIntegrationTest
public class SpotifyServiceIntegrationTest {
    ...
}
```

@DisplayName



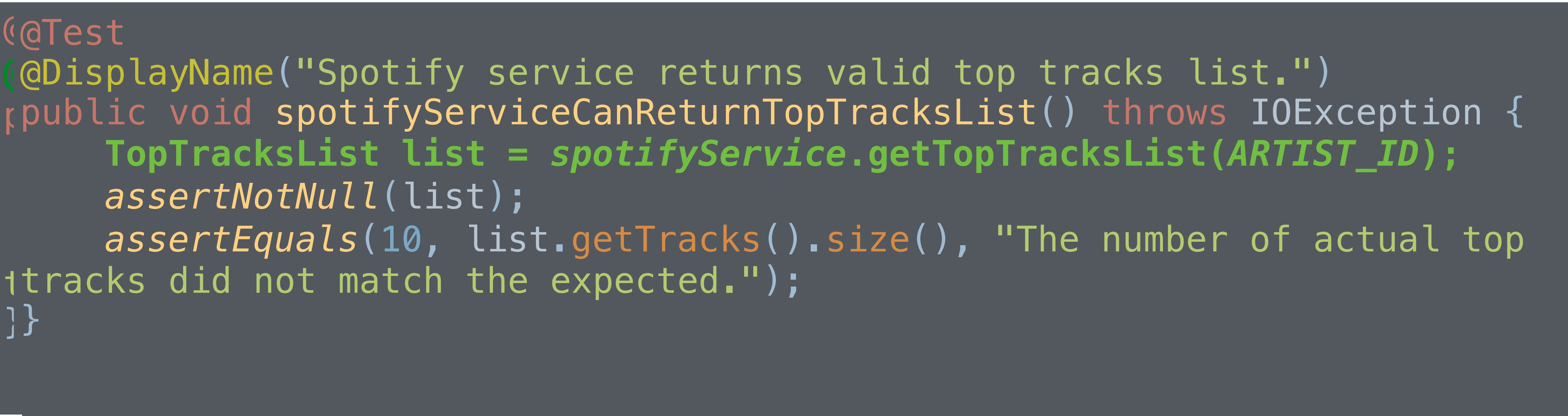
```
Debug  ArrayListTest.adding_one_item_to_arrayList_shouldIncrement_sizeOfList

▼ Test Results                                                      20ms
  ▼ ArrayListTest                                                   20ms
      adding_one_item_to_arrayList_shouldIncrement_sizeOfList()     20ms
```



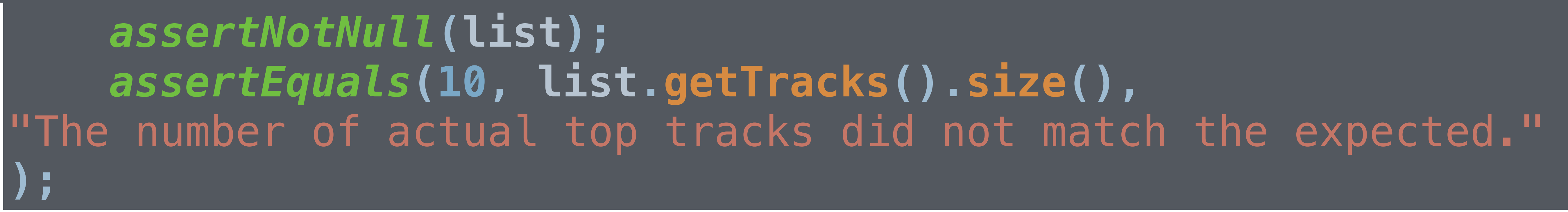
```
Debug  ArrayListTest.addingAnItemWorksWithDisplayName

▼ Test Results                                                              22ms
  ▼ ArrayListTest                                                           22ms
      Adding one item to an array list should increment the size of the list.   22ms
```

JUnit 5

Assertions

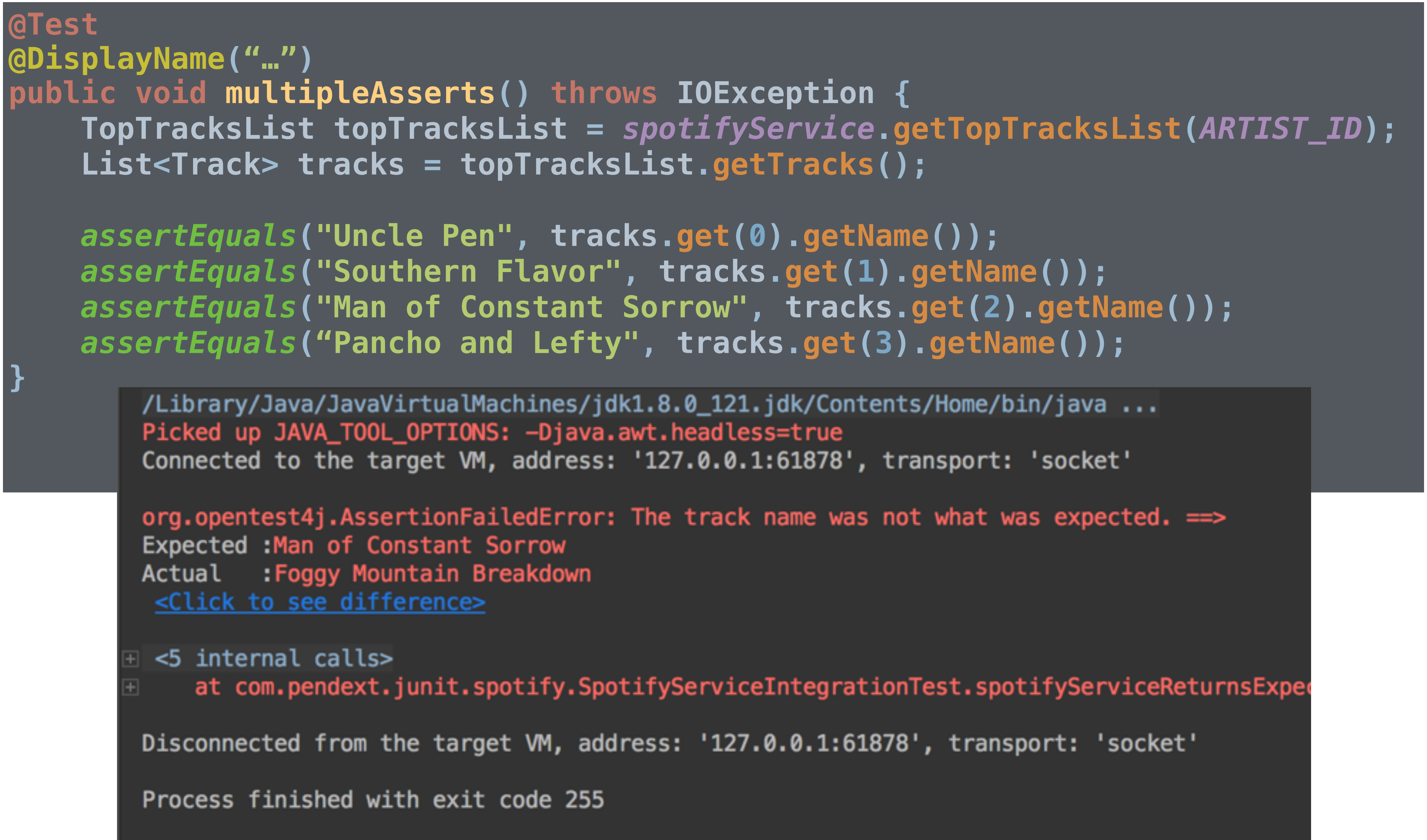


```java
@Test
@DisplayName("Spotify service returns valid top tracks list.")
public void spotifyServiceCanReturnTopTracksList() throws IOException {
    TopTracksList list = spotifyService.getTopTracksList(ARTIST_ID);
    assertNotNull(list);
    assertEquals(10, list.getTracks().size(), "The number of actual top
tracks did not match the expected.");
}
```



```java
    assertNotNull(list);
    assertEquals(10, list.getTracks().size(),
"The number of actual top tracks did not match the expected."
);
```

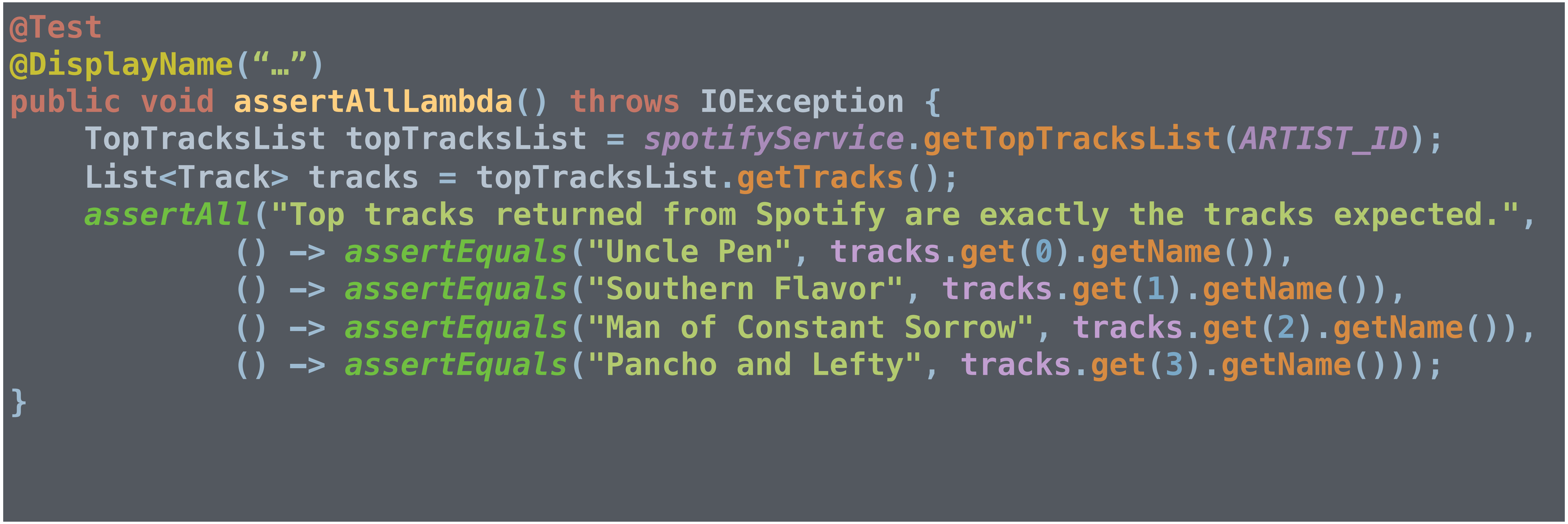
Assertions



```
@Test
@DisplayName(“…”)
public void multipleAsserts() throws IOException {
    TopTracksList topTracksList = spotifyService.getTopTracksList(ARTIST_ID);
    List<Track> tracks = topTracksList.getTracks();

    assertEquals("Uncle Pen", tracks.get(0).getName());
    assertEquals("Southern Flavor", tracks.get(1).getName());
    assertEquals("Man of Constant Sorrow", tracks.get(2).getName());
    assertEquals(“Pancho and Lefty", tracks.get(3).getName());
}
```

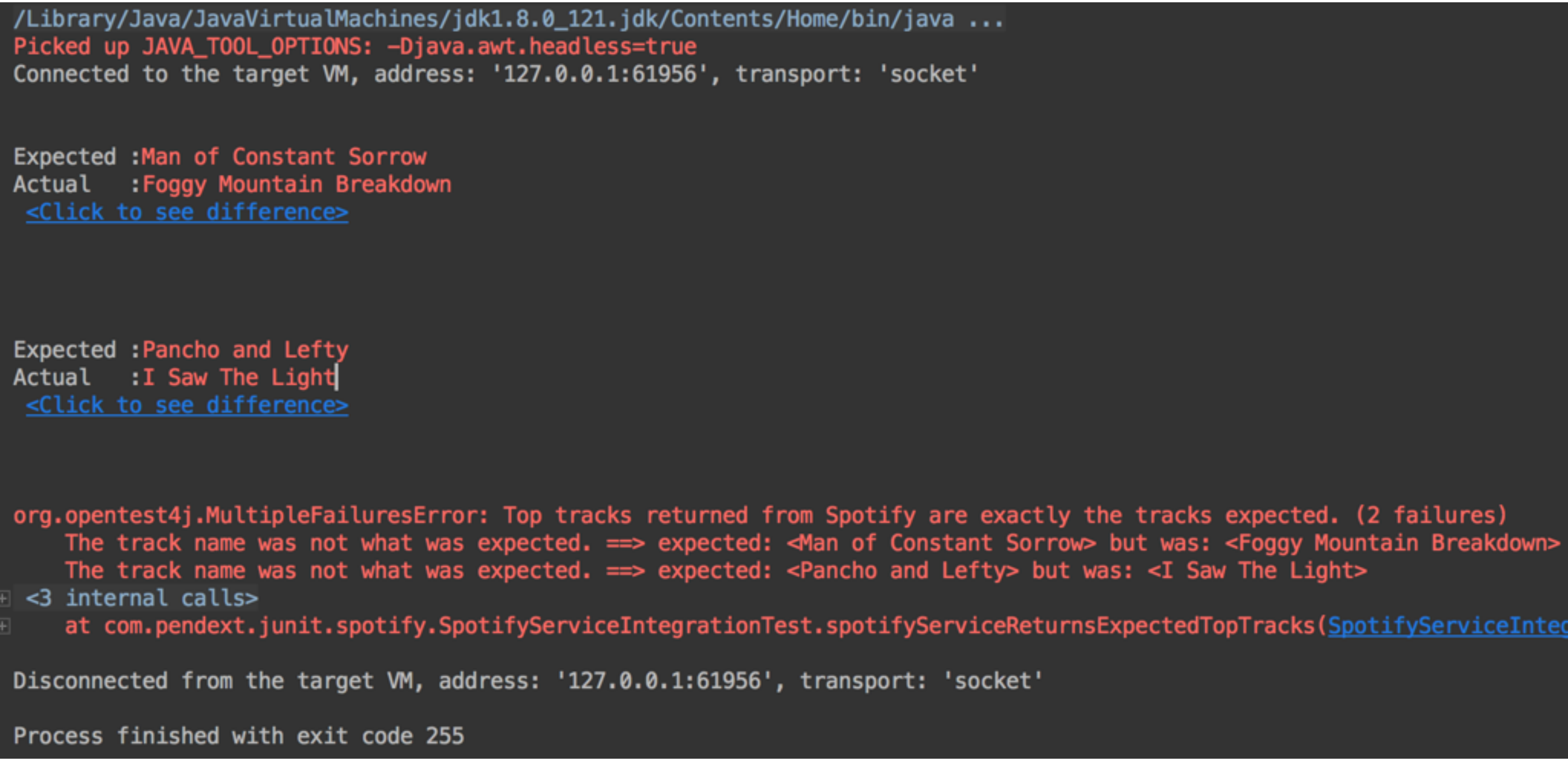
```
/Library/Java/JavaVirtualMachines/jdk1.8.0_121.jdk/Contents/Home/bin/java ...
Picked up JAVA_TOOL_OPTIONS: -Djava.awt.headless=true
Connected to the target VM, address: '127.0.0.1:61878', transport: 'socket'

org.opentest4j.AssertionFailedError: The track name was not what was expected. ==>
Expected :Man of Constant Sorrow
Actual   :Foggy Mountain Breakdown
 <Click to see difference>

 <5 internal calls>
    at com.pendext.junit.spotify.SpotifyServiceIntegrationTest.spotifyServiceReturnsExpe

Disconnected from the target VM, address: '127.0.0.1:61878', transport: 'socket'

Process finished with exit code 255
```

Assertions



```
@Test
@DisplayName(“…”)
public void assertAllLambda() throws IOException {
    TopTracksList topTracksList = spotifyService.getTopTracksList(ARTIST_ID);
    List<Track> tracks = topTracksList.getTracks();
    assertAll("Top tracks returned from Spotify are exactly the tracks expected.",
            () -> assertEquals("Uncle Pen", tracks.get(0).getName()),
            () -> assertEquals("Southern Flavor", tracks.get(1).getName()),
            () -> assertEquals("Man of Constant Sorrow", tracks.get(2).getName()),
            () -> assertEquals("Pancho and Lefty", tracks.get(3).getName()));
}
```

Assertions



```
/Library/Java/JavaVirtualMachines/jdk1.8.0_121.jdk/Contents/Home/bin/java ...
Picked up JAVA_TOOL_OPTIONS: -Djava.awt.headless=true
Connected to the target VM, address: '127.0.0.1:61956', transport: 'socket'


Expected :Man of Constant Sorrow
Actual   :Foggy Mountain Breakdown
 <Click to see difference>





Expected :Pancho and Lefty
Actual   :I Saw The Light
 <Click to see difference>




org.opentest4j.MultipleFailuresError: Top tracks returned from Spotify are exactly the tracks expected. (2 failures)
	The track name was not what was expected. ==> expected: <Man of Constant Sorrow> but was: <Foggy Mountain Breakdown>
	The track name was not what was expected. ==> expected: <Pancho and Lefty> but was: <I Saw The Light>
 <3 internal calls>
	at com.pendext.junit.spotify.SpotifyServiceIntegrationTest.spotifyServiceReturnsExpectedTopTracks(SpotifyServiceInte

Disconnected from the target VM, address: '127.0.0.1:61956', transport: 'socket'

Process finished with exit code 255
```

Assertions

JUnit 4 exception testing

```
@Test(expected = IOException.class)
public void exceptionTestingStrategy1() throws IOException {
    exceptionsExample.basicExceptionExample("message");
    fail("This code is unreachable!”); // test passes
}
```

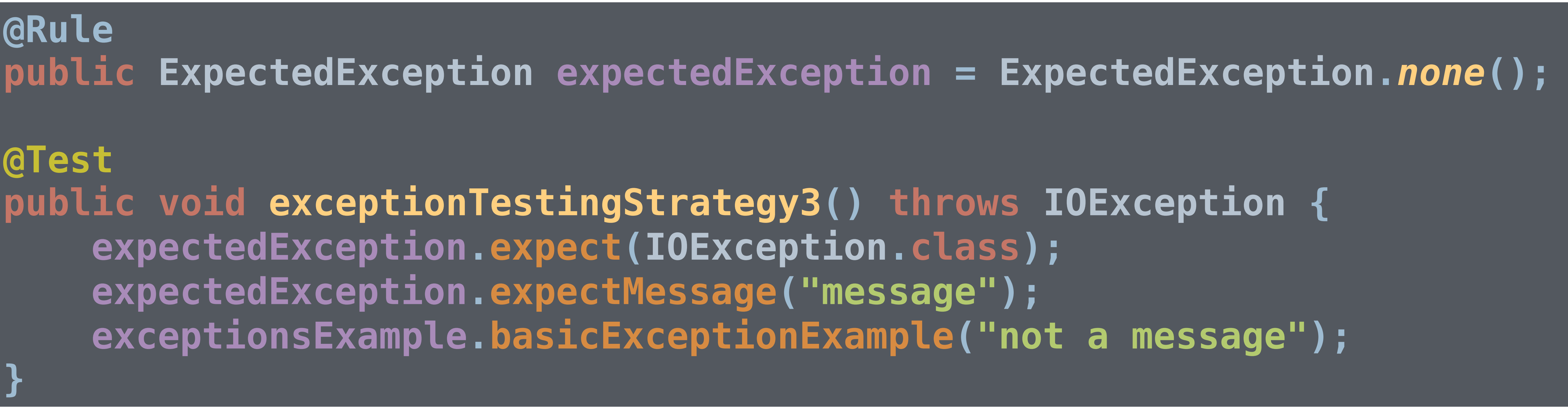
Assertions

JUnit 4 exception testing

```
@Test
public void exceptionTestingStrategy2() {
    String expectedMessage = RandomStringUtils.randomAlphanumeric(10);
    try {
        exceptionsExample.basicExceptionExample(expectedMessage);
    } catch (IOException e) {
        assertEquals(expectedMessage, e.getMessage());
    }
}
```

Assertions

JUnit 4 exception testing



```java
@Rule
public ExpectedException expectedException = ExpectedException.none();

@Test
public void exceptionTestingStrategy3() throws IOException {
    expectedException.expect(IOException.class);
    expectedException.expectMessage("message");
    exceptionsExample.basicExceptionExample("not a message");
}
```

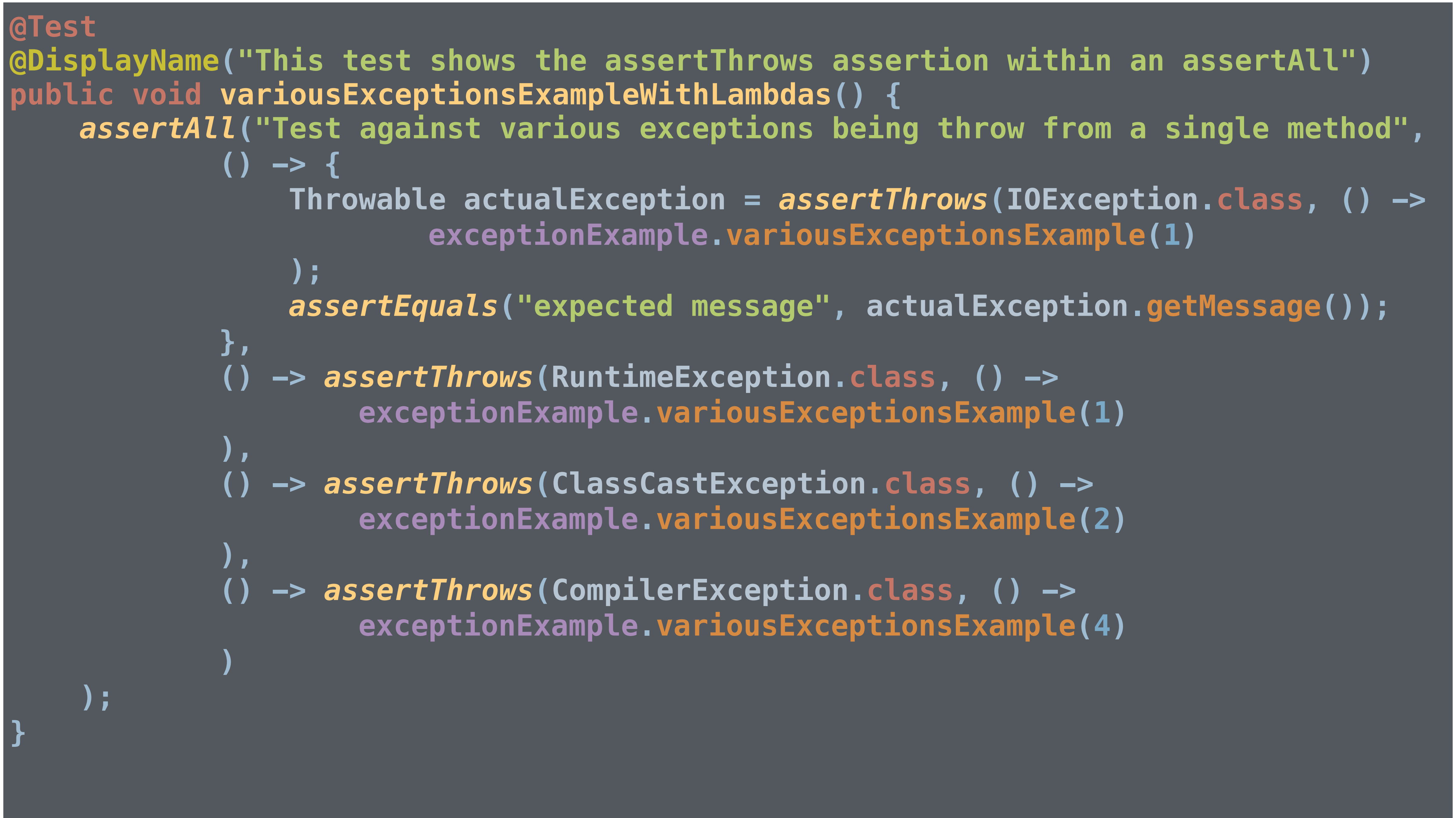
Assertions

Testing Exceptions

```java
@Test
@DisplayName("This test should throw an IO exception. ")
public void basicExceptionExample() {
    String expectedMessage = RandomStringUtils.randomAlphabetic(10);
    Throwable actualException = assertThrows(IOException.class, () ->
            exceptionExample.basicExceptionExample(expectedMessage)
    );
    assertEquals(expectedMessage, actualException.getMessage());
}
```

Assertions

Testing Exceptions



```java
@Test
@DisplayName("This test shows the assertThrows assertion within an assertAll")
public void variousExceptionsExampleWithLambdas() {
    assertAll("Test against various exceptions being throw from a single method",
            () -> {
                Throwable actualException = assertThrows(IOException.class, () ->
                        exceptionExample.variousExceptionsExample(1)
                );
                assertEquals("expected message", actualException.getMessage());
            },
            () -> assertThrows(RuntimeException.class, () ->
                    exceptionExample.variousExceptionsExample(1)
            ),
            () -> assertThrows(ClassCastException.class, () ->
                    exceptionExample.variousExceptionsExample(2)
            ),
            () -> assertThrows(CompilerException.class, () ->
                    exceptionExample.variousExceptionsExample(4)
            )
    );
}
```

Assertions

Third party assertion libraries

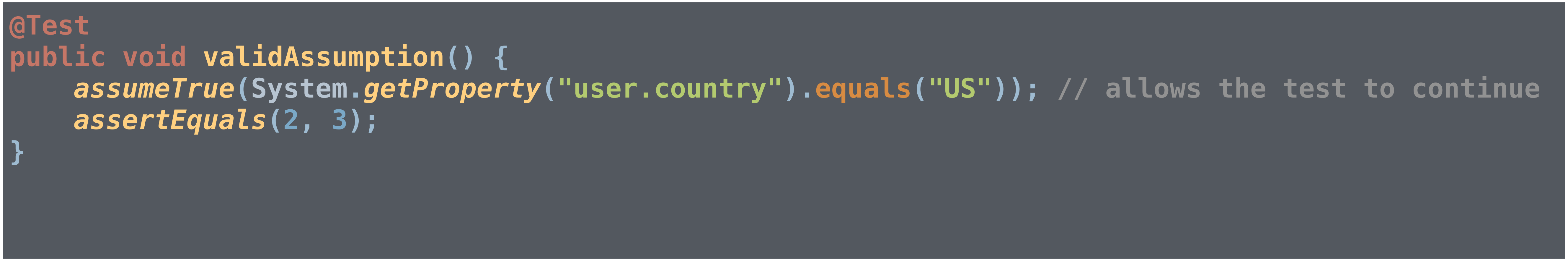
JUnit 5 does not have the equivalent of JUnit 4's `assertThat()` that takes a Hamcrest `Matcher`.

Developers are encouraged to use third party assertion libraries in conjunction with JUnit 5.

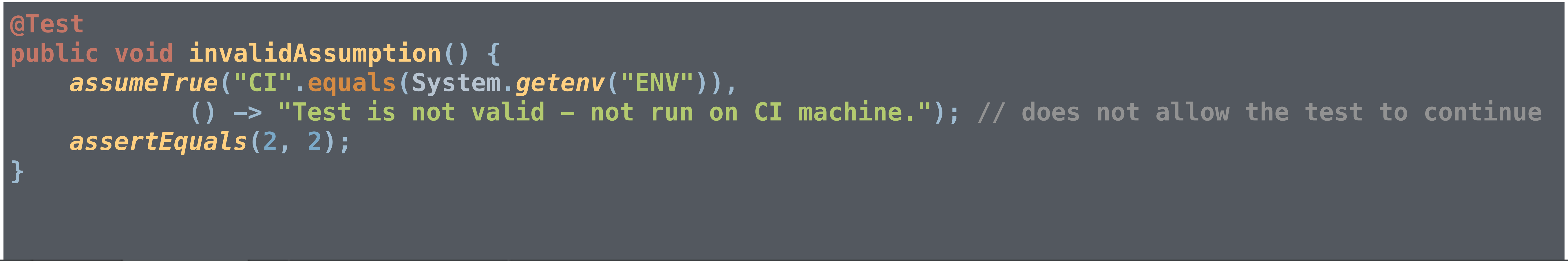
AssertJ

Hamcrest

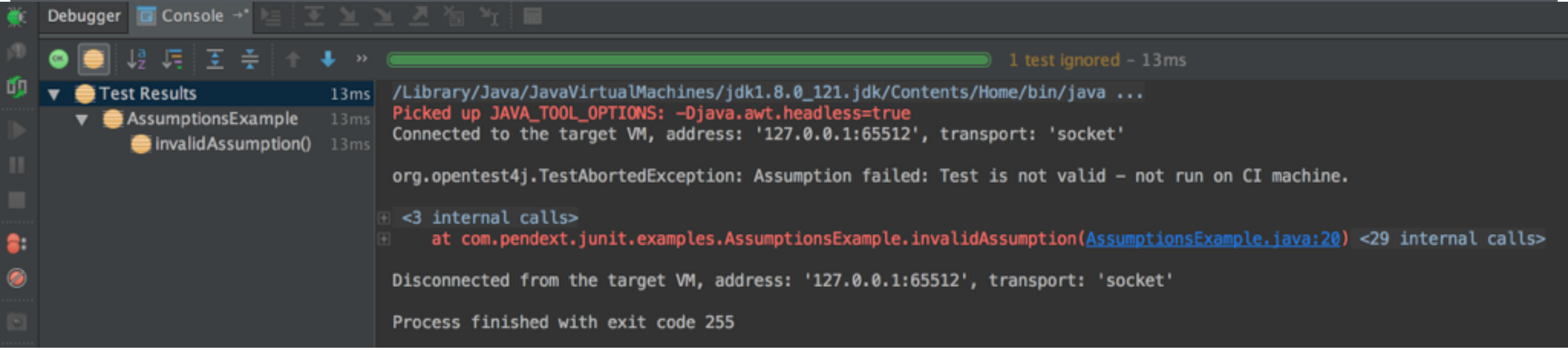
Assumptions



```java
@Test
public void validAssumption() {
    assumeTrue(System.getProperty("user.country").equals("US")); // allows the test to continue
    assertEquals(2, 3);
}
```

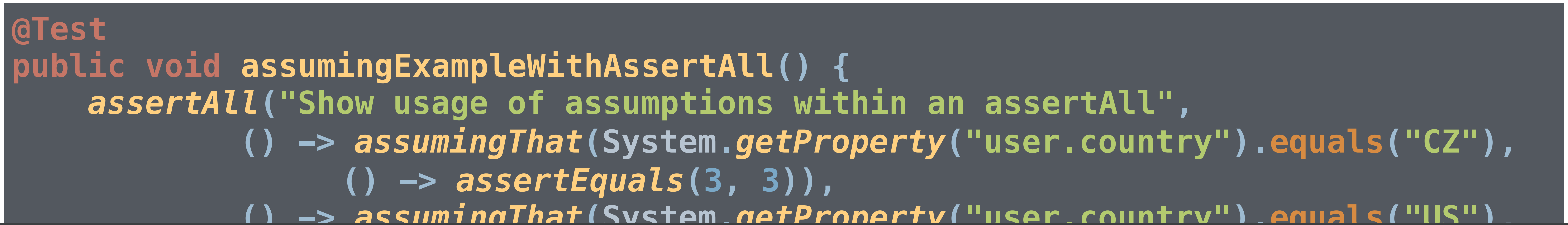


```java
@Test
public void invalidAssumption() {
    assumeTrue("CI".equals(System.getenv("ENV")),
            () -> "Test is not valid - not run on CI machine."); // does not allow the test to continue
    assertEquals(2, 2);
}
```

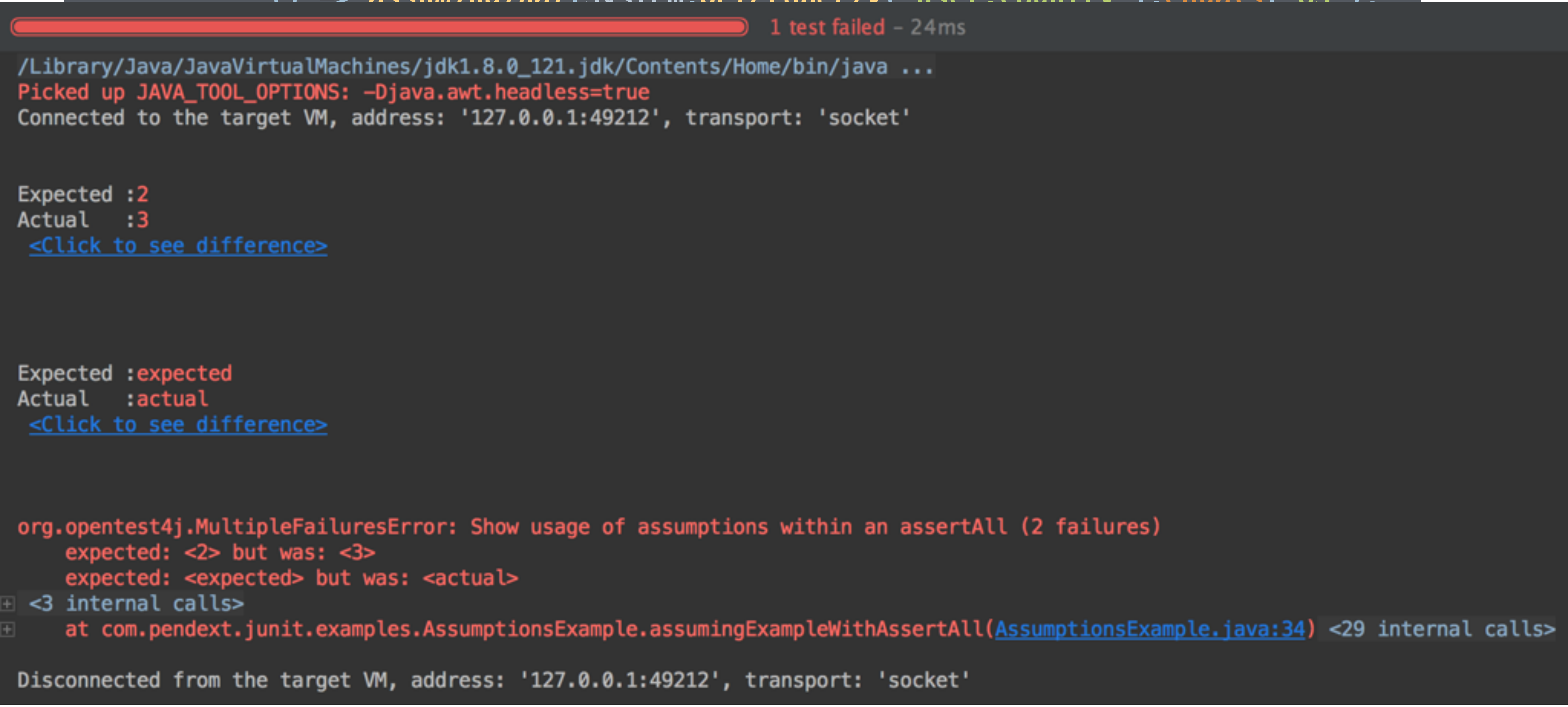


```
/Library/Java/JavaVirtualMachines/jdk1.8.0_121.jdk/Contents/Home/bin/java ...
Picked up JAVA_TOOL_OPTIONS: -Djava.awt.headless=true
Connected to the target VM, address: '127.0.0.1:65512', transport: 'socket'

org.opentest4j.TestAbortedException: Assumption failed: Test is not valid - not run on CI machine.

 <3 internal calls>
    at com.pendext.junit.examples.AssumptionsExample.invalidAssumption(AssumptionsExample.java:20) <29 internal calls>

Disconnected from the target VM, address: '127.0.0.1:65512', transport: 'socket'

Process finished with exit code 255
```

Assumptions



```
@Test
public void assumingExampleWithAssertAll() {
    assertAll("Show usage of assumptions within an assertAll",
            () -> assumingThat(System.getProperty("user.country").equals("CZ"),
                    () -> assertEquals(3, 3)),
            () -> assumingThat(System.getProperty("user.country").equals("US"),
```



```
/Library/Java/JavaVirtualMachines/jdk1.8.0_121.jdk/Contents/Home/bin/java ...
Picked up JAVA_TOOL_OPTIONS: -Djava.awt.headless=true
Connected to the target VM, address: '127.0.0.1:49212', transport: 'socket'


Expected :2
Actual   :3
 <Click to see difference>




Expected :expected
Actual   :actual
 <Click to see difference>



org.opentest4j.MultipleFailuresError: Show usage of assumptions within an assertAll (2 failures)
    expected: <2> but was: <3>
    expected: <expected> but was: <actual>
 <3 internal calls>
    at com.pendext.junit.examples.AssumptionsExample.assumingExampleWithAssertAll(AssumptionsExample.java:34) <29 internal calls>

Disconnected from the target VM, address: '127.0.0.1:49212', transport: 'socket'
```

Tagging and Filtering

```java
@Target({ ElementType.TYPE, ElementType.METHOD })
@Retention(RetentionPolicy.RUNTIME)
@Tag("integration")
public @interface IntegrationTest {
}
```

```java
@Target({ ElementType.TYPE, ElementType.METHOD })
@Retention(RetentionPolicy.RUNTIME)
@IntegrationTest
@Tag("requires network")
public @interface NetworkIntegrationTest {
}
```

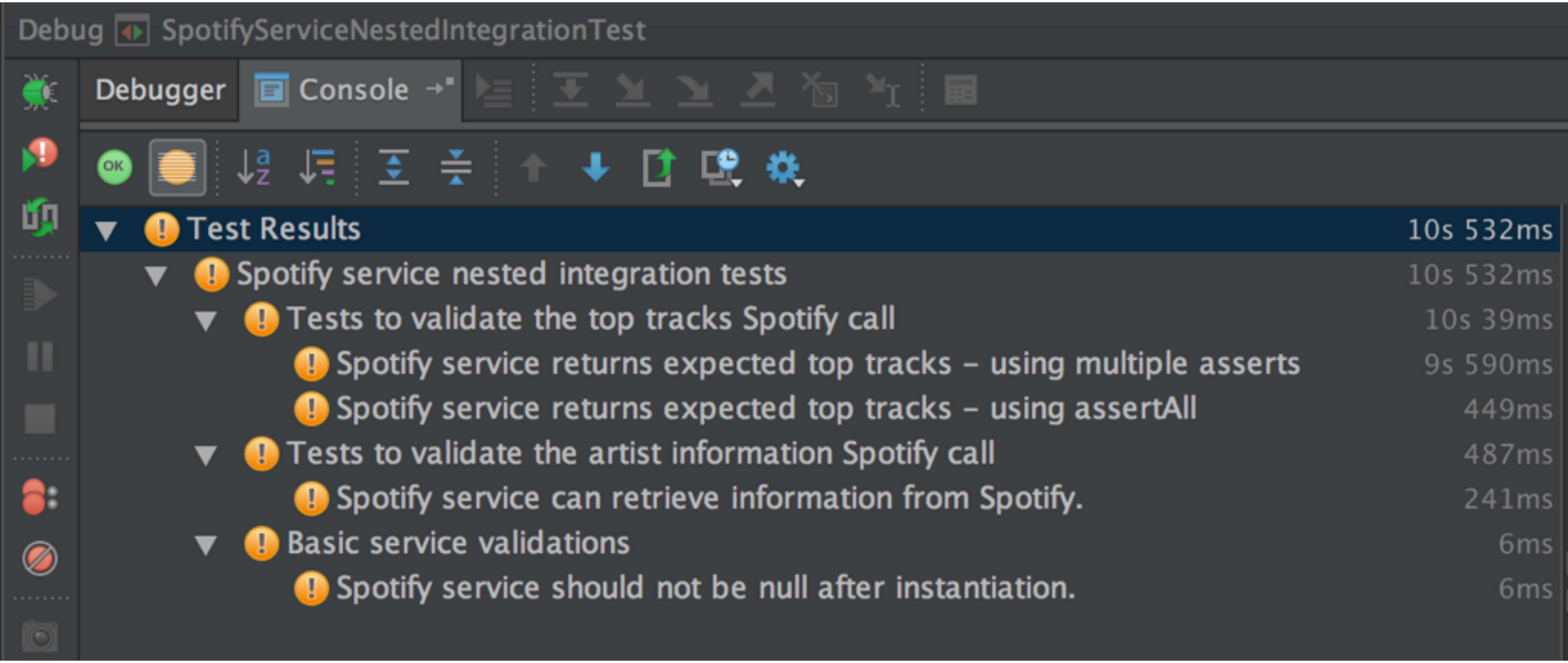
```xml
<artifactId>maven-surefire-plugin</artifactId>
<version>2.19</version>
<configuration>
    <goal>
        <properties>
            <includeTags>*</includeTags>
            <excludeTags>integration</excludeTags>
        </properties>
    </goal>
</configuration>
```

Nested Tests

```
class SpotifyServiceNestedIntegrationTest {
    private static SpotifyService spotifyService;
    private final String ARTIST_ID = “5CWbfANRpZbnxdstzcNg5H";

    @BeforeEach
    public void beforeEach() {
        spotifyService = new SpotifyService();
    }

    @Nested
    @DisplayName("Basic service validations")
    class BasicTest {
        @Test
        @DisplayName("Spotify service should not be null after instantiation.")
        public void spotifyServiceCanBeInstantiated() {
            assertTrue(spotifyService != null);
        }
    }

    …

}
```

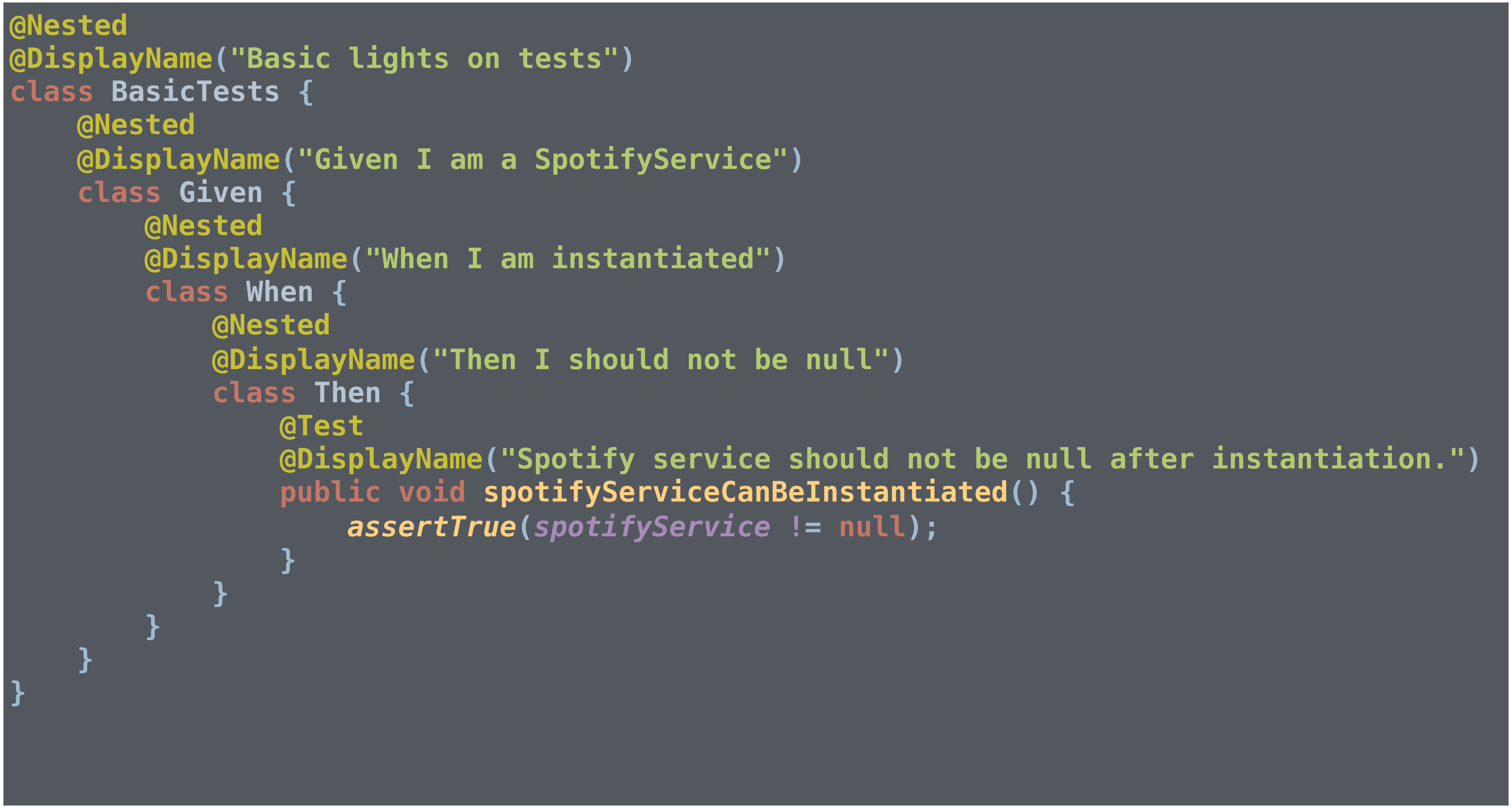
JUnit 5

Nested Tests



```
▼ Test Results                                                                   10s 532ms
  ▼ Spotify service nested integration tests                                     10s 532ms
    ▼ Tests to validate the top tracks Spotify call                              10s 39ms
        Spotify service returns expected top tracks – using multiple asserts     9s 590ms
        Spotify service returns expected top tracks – using assertAll            449ms
    ▼ Tests to validate the artist information Spotify call                      487ms
        Spotify service can retrieve information from Spotify.                   241ms
    ▼ Basic service validations                                                  6ms
        Spotify service should not be null after instantiation.                  6ms
```

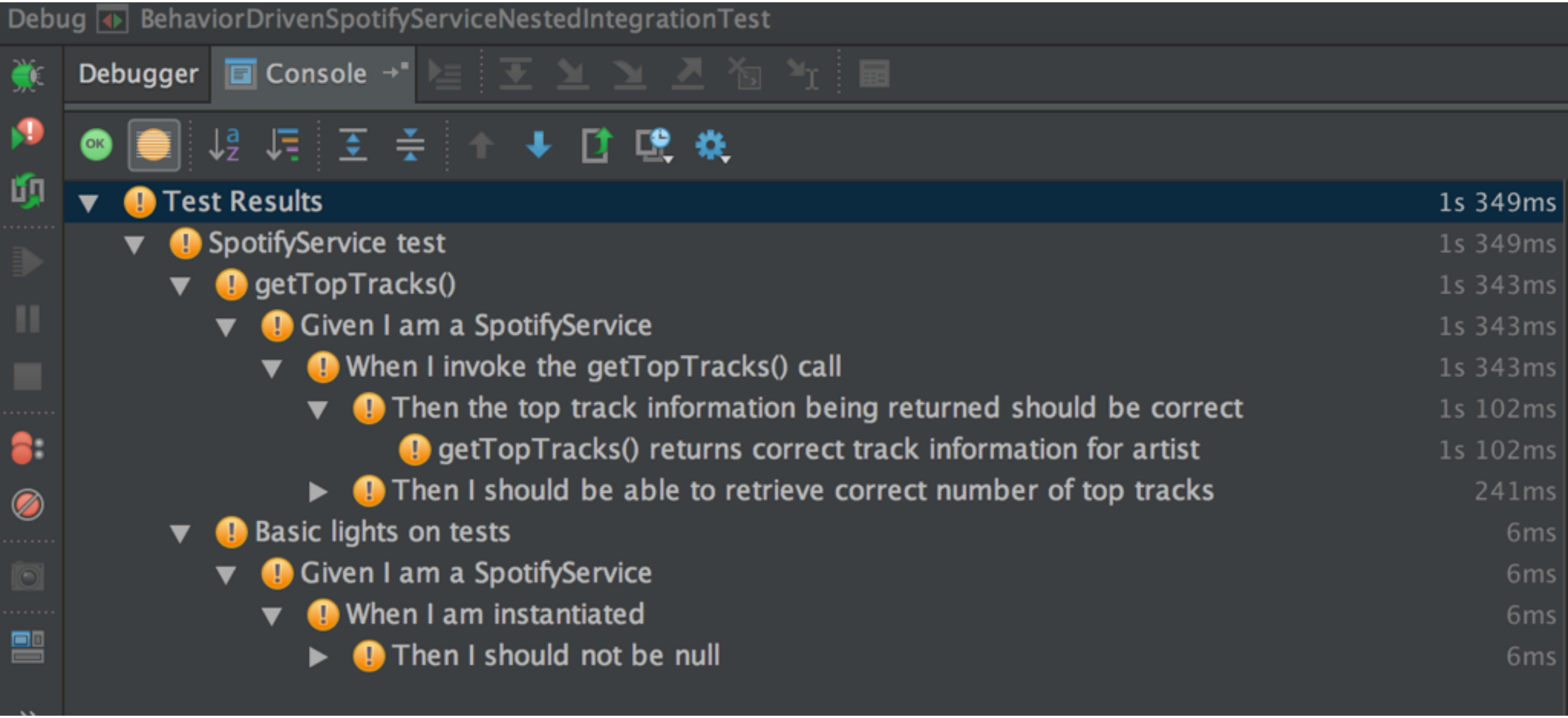
BDD Style Tests



```
@Nested
@DisplayName("Basic lights on tests")
class BasicTests {
    @Nested
    @DisplayName("Given I am a SpotifyService")
    class Given {
        @Nested
        @DisplayName("When I am instantiated")
        class When {
            @Nested
            @DisplayName("Then I should not be null")
            class Then {
                @Test
                @DisplayName("Spotify service should not be null after instantiation.")
                public void spotifyServiceCanBeInstantiated() {
                    assertTrue(spotifyService != null);
                }
            }
        }
    }
}
```

JUnit 5

BDD Style Tests

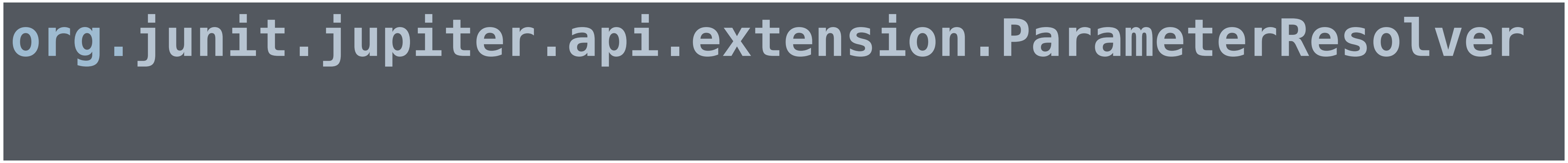


```
▼ Test Results                                                         1s 349ms
  ▼ SpotifyService test                                                1s 349ms
    ▼ getTopTracks()                                                   1s 343ms
      ▼ Given I am a SpotifyService                                    1s 343ms
        ▼ When I invoke the getTopTracks() call                        1s 343ms
          ▼ Then the top track information being returned should be correct   1s 102ms
              getTopTracks() returns correct track information for artist     1s 102ms
          ▶ Then I should be able to retrieve correct number of top tracks     241ms
    ▼ Basic lights on tests                                                 6ms
      ▼ Given I am a SpotifyService                                         6ms
        ▼ When I am instantiated                                            6ms
          ▶ Then I should not be null                                       6ms
```

Constructor and Method Injection

Prior to JUnit 5 test methods and constructors were unable to have parameters (using the standard `Runner` implementation).

In JUnit 5…



```
org.junit.jupiter.api.extension.ParameterResolver
```

Defines the API for injecting parameters dynamically at runtime.

Constructor and Method Injection

```
org.junit.jupiter.api.extension.ParameterResolver
```

Applies to

```
public TestConstructor() { … }, @Test, @TestFactory,
@BeforeEach, @AfterEach, @BeforeAll, @AfterAll
```

As long as the parameter can be resolved at runtime with a registered `ParameterResolver`

Constructor and Method Injection

Built in `ParameterResolver`s

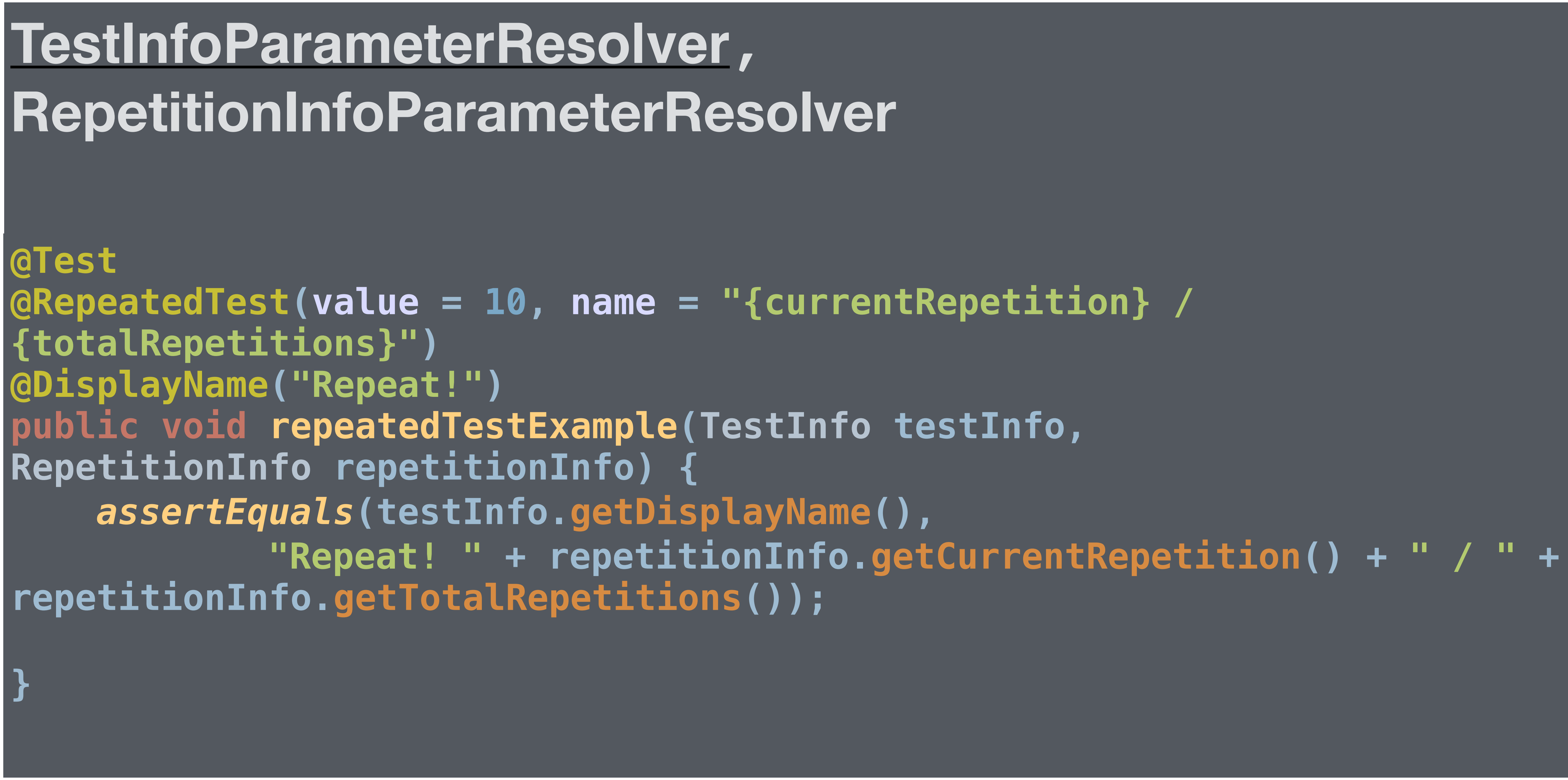
TestInfoParameterResolver

RepetitionInfoParameterResolver

TestReporterParameterResolver

JUnit 5

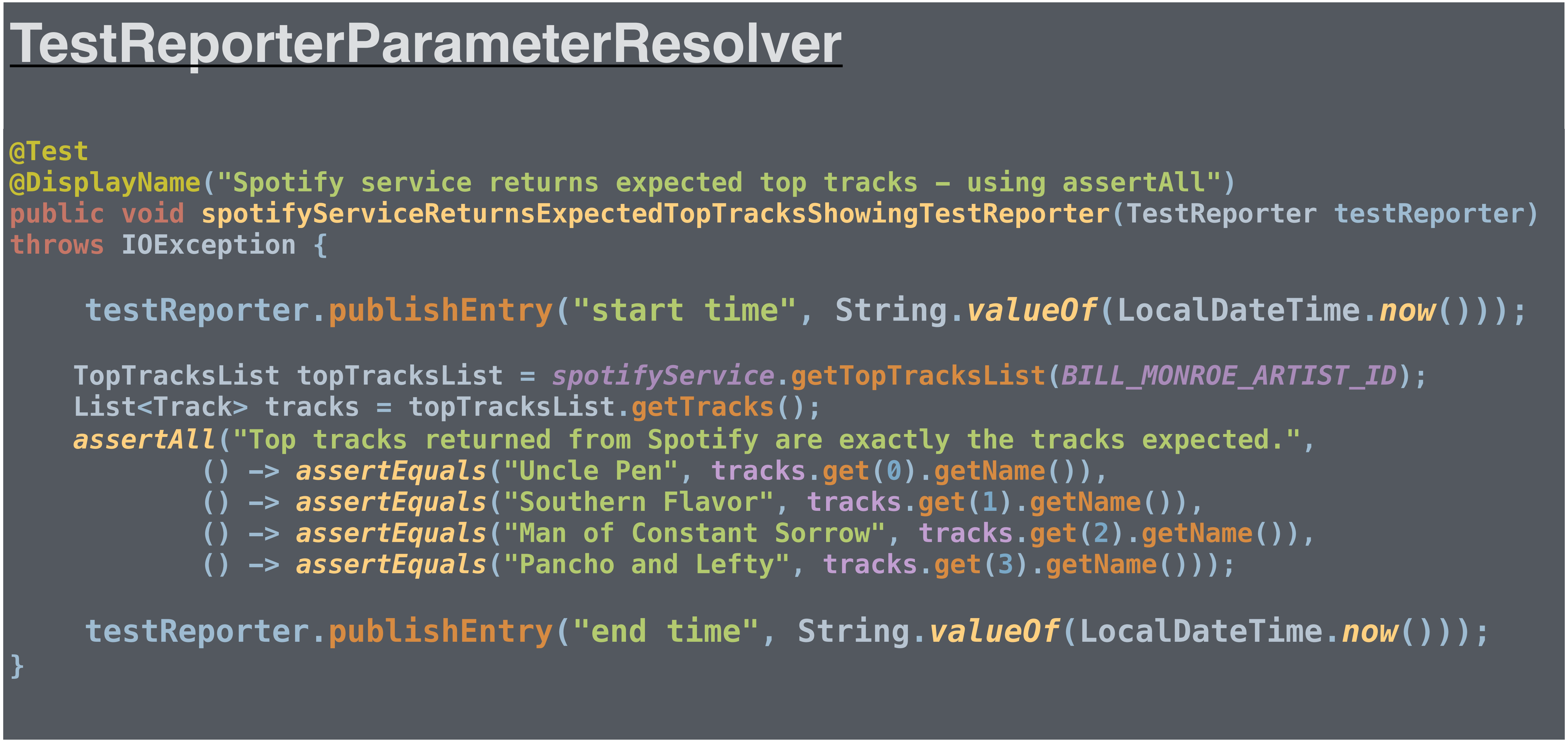
Constructor and Method Injection



TestInfoParameterResolver, RepetitionInfoParameterResolver

```
@Test
@RepeatedTest(value = 10, name = "{currentRepetition} /
{totalRepetitions}")
@DisplayName("Repeat!")
public void repeatedTestExample(TestInfo testInfo,
RepetitionInfo repetitionInfo) {
    assertEquals(testInfo.getDisplayName(),
            "Repeat! " + repetitionInfo.getCurrentRepetition() + " / " +
repetitionInfo.getTotalRepetitions());

}
```

Constructor and Method Injection



TestReporterParameterResolver

```java
@Test
@DisplayName("Spotify service returns expected top tracks - using assertAll")
public void spotifyServiceReturnsExpectedTopTracksShowingTestReporter(TestReporter testReporter)
throws IOException {

    testReporter.publishEntry("start time", String.valueOf(LocalDateTime.now()));

    TopTracksList topTracksList = spotifyService.getTopTracksList(BILL_MONROE_ARTIST_ID);
    List<Track> tracks = topTracksList.getTracks();
    assertAll("Top tracks returned from Spotify are exactly the tracks expected.",
            () -> assertEquals("Uncle Pen", tracks.get(0).getName()),
            () -> assertEquals("Southern Flavor", tracks.get(1).getName()),
            () -> assertEquals("Man of Constant Sorrow", tracks.get(2).getName()),
            () -> assertEquals("Pancho and Lefty", tracks.get(3).getName()));

    testReporter.publishEntry("end time", String.valueOf(LocalDateTime.now()));
}
```

Default Methods/Test Interfaces

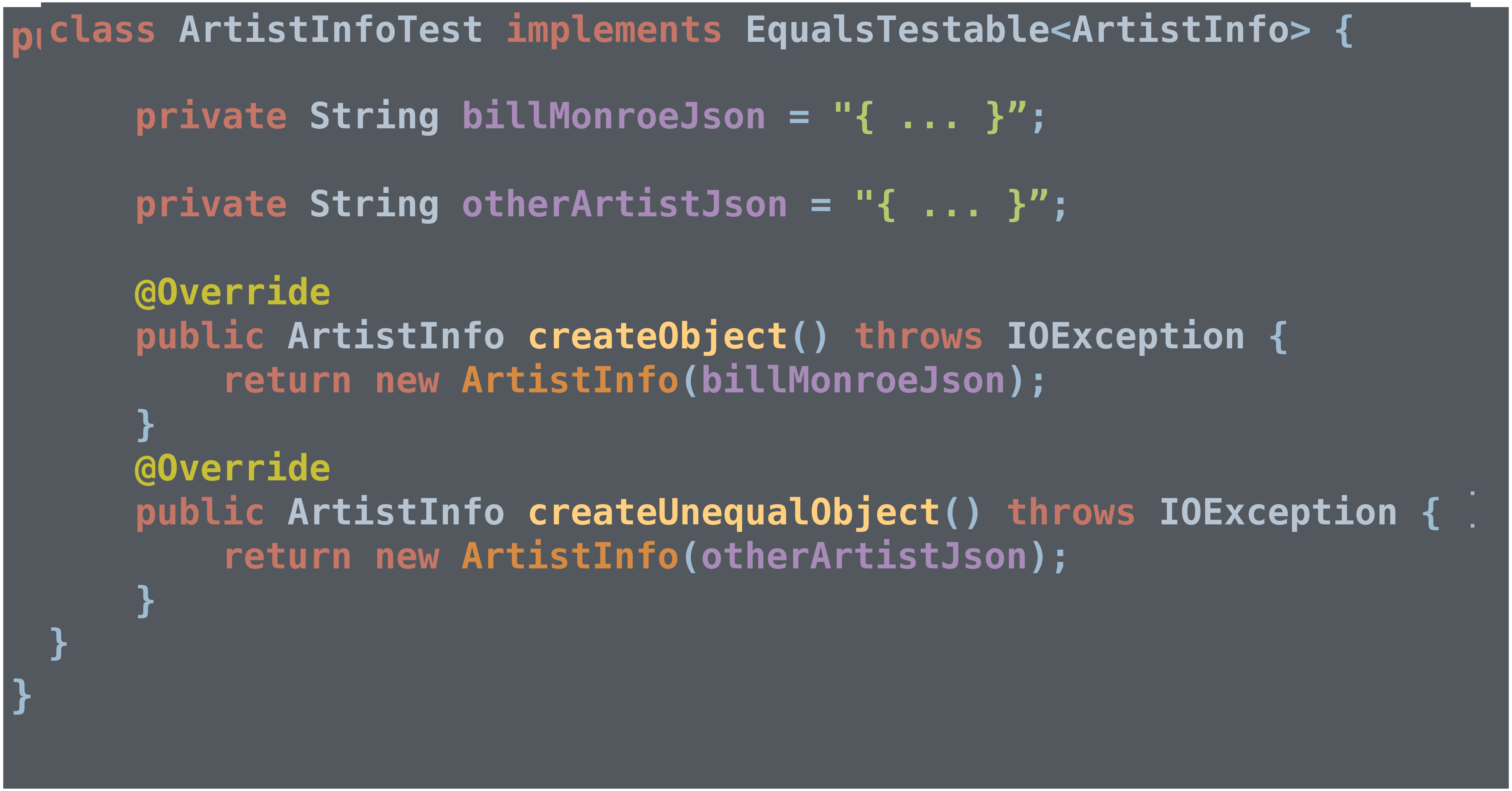
```java
public interface DefaultMethodInterface {

    default void defaultMethod() {
        // default code goes here
    }

}
```

Default Methods/Test Interfaces

```java
public interface TestDecorator {

    Logger logger = LoggerFactory.getLogger(“test-logger");

    @BeforeAll
    static void beforeAll() {
        // logging or other work here
    }
    @AfterAll
    static void afterAll() {
        // logging or other work here
    }
    @BeforeEach
    default void beforeEach(TestInfo testInfo) {
        // logging or other work here
    }
    @AfterEach
    default void afterEach(TestInfo testInfo) {
        // logging or other work here
    }
}
```

Default Methods/Test Interfaces

Creating tests against interface contracts

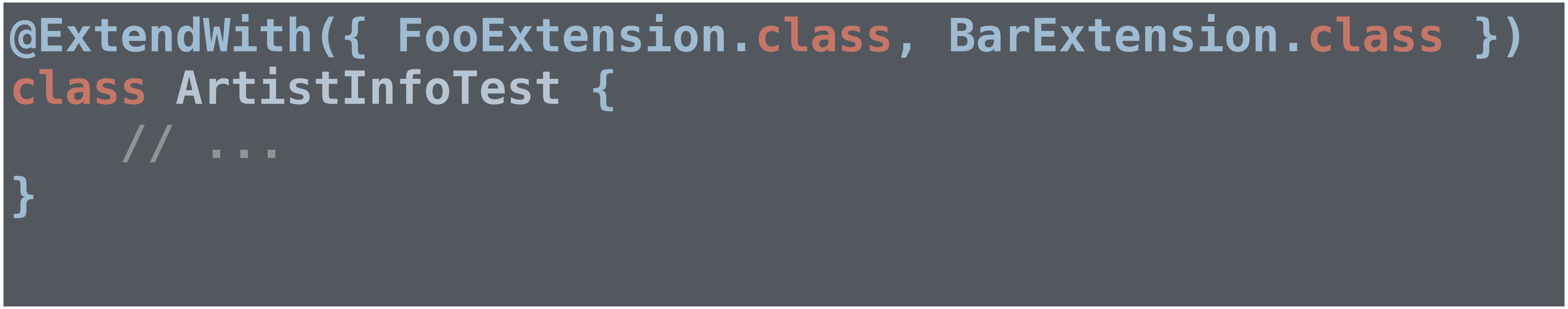


```
puclass ArtistInfoTest implements EqualsTestable<ArtistInfo> {

      private String billMonroeJson = "{ ... }”;

      private String otherArtistJson = "{ ... }”;

      @Override
      public ArtistInfo createObject() throws IOException {
          return new ArtistInfo(billMonroeJson);
      }
      @Override
      public ArtistInfo createUnequalObject() throws IOException {
          return new ArtistInfo(otherArtistJson);
      }
  }
}
```

Extension Model

JUnit 4 had `Runner`, `@Rule`, and `@ClassRule` for extending the behavior of test classes

JUnit 5 has the annotation `@ExtendWith(ExtensionClass.class)`



```
@ExtendWith({ FooExtension.class, BarExtension.class })
class ArtistInfoTest {
    // ...
}
```

Extension Model

`@ExtendWith` defines a set of APIs for extending the behavior of JUnit 5 test classes

```
ContainerExecutionCondition
TestExecutionCondition
```

```
TestInstancePostProcessor
```

```
ParameterResolver
```

Extension Model

JUnit 5 also includes container/test level execution callbacks as part of the extension model

```
BeforeAllCallback
    BeforeEachCallback
        BeforeTestExecutionCallback
        AfterTestExecutionCallback
    AfterEachCallback
AfterAllCallback
```

Upgrading from JUnit 4

Although the JUnit Jupiter programming model and extension model will not support JUnit 4 features such as `Rules` and `Runners` natively, it is not expected that source code maintainers will need to update all of their existing tests, test extensions, and custom build test infrastructure to migrate to JUnit Jupiter.

Source: http://junit.org/junit5/docs/current/user-guide/#migrating-from-junit4

Upgrading from JUnit 4

But what about my JUnit 4 (or even, *gasp* JUnit 3) tests?

Just make sure you have the junit-vintage-engine artifact included in your project and the existing tests will be picked up by the JUnit Platform Launcher.

Source: http://junit.org/junit5/docs/current/user-guide/#migrating-from-junit4

Upgrading from JUnit 4

Limited JUnit 4 `Rule` Support

`org.junit.rules.ExternalResource` (including `org.junit.rules.TemporaryFolder`)

`org.junit.rules.Verifier` (including `org.junit.rules.ErrorCollector`)

`org.junit.rules.ExpectedException`

Source: http://junit.org/junit5/docs/current/user-guide/#migrating-from-junit4

Upgrading from JUnit 4

Limited JUnit 4 `Rule` Support

These `Rule`s will work unchanged in legacy test suites.

Source: http://junit.org/junit5/docs/current/user-guide/#migrating-from-junit4

What is missing or still in development?

Spring Framework Integration (in progress)
Mocking Framework Integration (in process)
An initial release candidate!

Resources

http://junit.org/junit5/

https://github.com/junit-team/junit5-samples/tree/master/junit5-mockito-extension

https://github.com/sbrannen/spring-test-junit5

https://github.com/pendext

JUnit

Questions?