The Pragmatic Programmers

Pragmatic Unit Testing in Java with JUnit

Third Edition

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Organizing Related Tests into Nested Classes

As your classes grow by taking on more behaviors, you'll need more and more tests to describe the new behaviors. Use your test class size as a hint: if you declare several dozen tests in one test source file, chances are good that the class under test is too large. Consider splitting the production class up into two or more classes, which also means you'll want to split the test methods across at least two or more test classes.

You may still end up with a couple dozen test methods in one test class. A larger test class can not only be daunting from a navigational sense, but it can also make it harder to find all tests that relate to each other.

To help group related tests, you might consider starting each related test's name with the same thing. Here are three tests describing how withdrawals work in the `Account` class:

```
@Test void withdrawalReducesAccountBalance() { /* ... */ }
@Test void withdrawalThrowsWhenAmountExceedsBalance() { /* ... */ }
@Test void withdrawalNotifiesIRSWhenAmountExceedsThreshold() { /* ... */ }
```

A better solution, however, is to group related tests within a JUnit `@Nested` class:

```
@Nested
class Withdrawal {
   @Test void reducesAccountBalance() { /* ... */ }
   @Test void throwsWhenAmountExceedsBalance() { /* ... */ }
   @Test void notifiesIRSWhenAmountExceedsThreshold() { /* ... */ }
}
```

You can create a number of `@Nested` classes within your test class, similarly grouping all methods within it. The name of the nested class, which describes the common behavior, can be removed from each test name.

You can also use `@Nested` classes to group tests by context—the state established by the `arrange` part of a test. For example:

```
class AnAccount
   @Nested
   class WithZeroBalance {
     @Test void doesNotAccrueInterest() { /* ... */ }
     @Test void throwsOnWithdrawal() { /* ... */ }
  }
```

```
  @Nested
  class WithPositiveBalance {
     @BeforeEach void fundAccount() { account.deposit(1000); }
     @Test void accruesInterest() { /* ... */ }
     @Test void reducesBalanceOnWithdrawal() { /* ... */ }
  }
}
```

Tests are split between those needing a zero-balance account (WithZeroBalance) and those needing a positive account balance (WithPositiveBalance).

Observing the JUnit Lifecycle

You've learned about using before and after hooks and how to group related tests into nested classes. Using a skeleton test class, let's take a look at how these JUnit elements are actually involved when you run your tests.

AFundedAccount contains six tests. Per its name, all tests can assume that an account exists and has a positive balance. An account object gets created at the field level and subsequently funded within a @BeforeEach method. Here's the entire AFundedAccount test class, minus all the intricate details of each test.

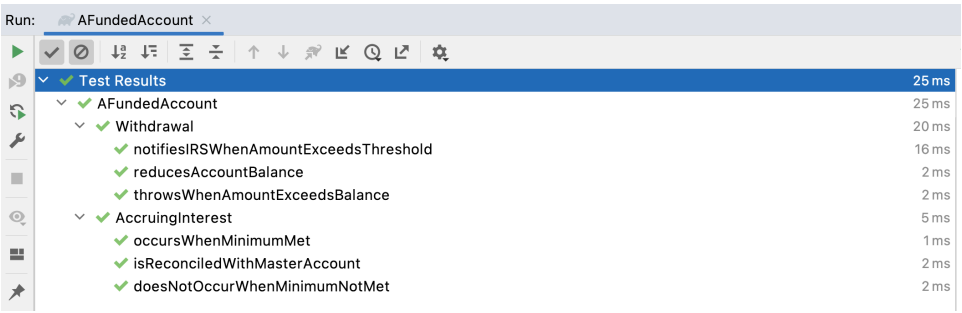
utj3-junit/01/src/test/java/scratch/AFundedAccount.java

```
import org.junit.jupiter.api.*;

class AFundedAccount {
   Account account = new Account("Jeff");
   AFundedAccount() {
      // ...
   }

   @BeforeEach
   void fundAccount() {
      account.deposit(1000);
   }

   @BeforeAll
   static void clearAccountRegistry() {
      // ...
   }

   @Nested
   class AccruingInterest {

      @BeforeEach
      void setInterestRate() {
         account.setInterestRate(0.027d);
      }

      @Test
      void occursWhenMinimumMet() {
         // ...
      }
```

```
        @Test
        void doesNotOccurWhenMinimumNotMet() {
            // ...
        }

        @Test
        void isReconciledWithMasterAccount() {
            // ...
        }
    }

    @Nested
    class Withdrawal {

        @Test
        void reducesAccountBalance() {
            // ...
        }

        @Test
        void throwsWhenAmountExceedsBalance() {
            // ...
        }

        @Test
        void notifiesIRSWhenAmountExceedsThreshold() {
            // ...
        }
    }
}
```

While you could choose to instantiate the `account` field in a `@BeforeEach` method, there's nothing wrong with doing field-level initialization, particularly if there's not much going on. The field declaration in `AFundedAccount` initializes an `account` with some arbitrary name, so it's not interesting enough to warrant a `@BeforeEach` method. But if your common initialization is at all interesting or requires a series of statements, you'd definitely want it to occur within a `@BeforeEach` method.

The use of `@Nested` makes for well organized test results when you run your tests:



You can clearly see the grouping of related tests, which makes it easier to find what you're looking for. The visual grouping also makes it easier to spot the glaring absence of necessary tests as well as review their names for consistency—with other tests or with your team's standards for how tests are named.

I instrumented each of the @BeforeEach methods, the @Test methods, and the constructors (implicitly defined in the listing) with System.out statements. Here's the output when the tests are run:

```
@BeforeAll::clearAccountRegistry
AFundedAccount(); Jeff balance = 0
        Withdrawal
                @BeforeEach::fundAccount
                notifiesIRSWhenAmountExceedsThreshold
AFundedAccount(); Jeff balance = 0
        Withdrawal
                @BeforeEach::fundAccount
                reducesAccountBalance
AFundedAccount(); Jeff balance = 0
        Withdrawal
                @BeforeEach::fundAccount
                throwsWhenAmountExceedsBalance
AFundedAccount(); Jeff balance = 0
        Accruing Interest
                @BeforeEach::fundAccount
                @BeforeEach::setInterestRate
                occursWhenMinimumMet
AFundedAccount(); Jeff balance = 0
        Accruing Interest
                @BeforeEach::fundAccount
                @BeforeEach::setInterestRate
                accruesNoInterestWhenMinimumMet
AFundedAccount(); Jeff balance = 0
        Accruing Interest
                @BeforeEach::fundAccount
                @BeforeEach::setInterestRate
                doesNotOccurWhenMinimumNotMet
```

The static @BeforeAll method executes first.

The output shows that a new instance of AFundedAccount is constructed for each test executed. It also shows that the account is, as expected, properly initialized with a name and zero balance.

Creating a new instance for each test is part of JUnit's deliberate design. It helps ensure each test is isolated from side effects that other tests might create.

JUnit creates a new instance of the test class for each test method that runs.

The `@BeforeEach` method `fundAccount`, declared within the top-level scope of the `AFundedAccount` class, executes prior to each of all six tests.

The `@BeforeEach` method `setInterestRate`, declared within the scope of `AccruingInterest`, executes only prior to each of the three tests defined within that nested class.