

Manual testing

How-to

- Write code
- Manually run it
- Manually check it
- What can go wrong?
- What can be missing?

What can go wrong

- Incorrect execution
- Misread results
- Forgotten tests
- ...

What can be missing

- Multiple users
- Time dependencies
- Location dependencies
- ...

Automated testing

How-to

- Write code
- Write test code
- Run tests

Benefits

- No forgetting tests
- No mistakes running tests
- No effort to run
- Can “fake” parts of the system

	Manual	Automated
Fixed cost	Low	High
Variable cost	High	Low
Input	Requirement	Specification
Human error	Yes	No
Edge cases	No	Yes

JUnit

@Test

```
void onePlusOneIsTwo() {  
    assertEquals(1 + 1, 2);  
}
```

assertEquals

```
public static void assertEquals(int expected,  
                                int actual)
```

JUnit + Hamcrest

```
@Test
```

```
void onePlusOneIsTwo() {  
    assertThat(1 + 1, is(2));  
}
```

JUnit + Hamcrest

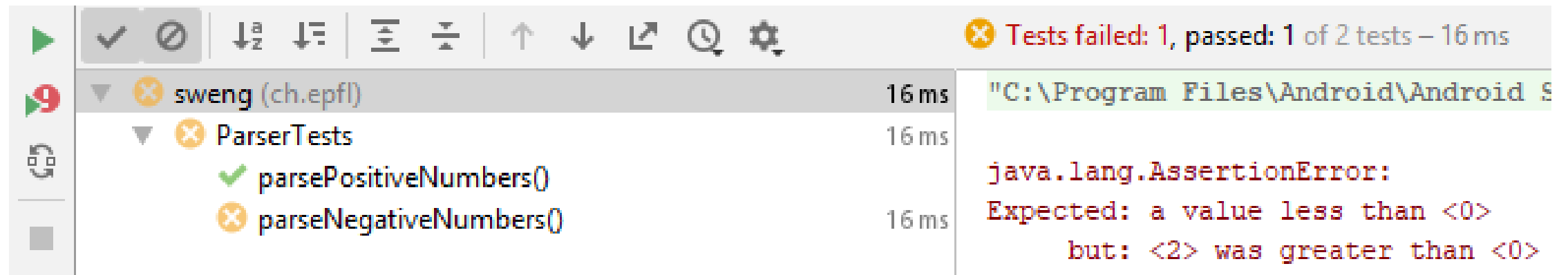
@Test

Expected: (an empty collection
or iterable containing [<1>, <2>, <3>])
but: was <[42]>

```
either(empty())  
.or(contains(1, 2, 3));
```

```
}
```

IntelliJ (and others)



The screenshot shows the IntelliJ IDEA test runner interface. At the top, a toolbar contains icons for running, debugging, and other test-related actions. To the right of the toolbar, a status bar indicates "Tests failed: 1, passed: 1 of 2 tests – 16 ms". Below the toolbar, a tree view shows the test hierarchy: "sweng (ch.epfl)" is expanded, showing "ParserTests" which contains two sub-items: "parsePositiveNumbers()" (marked with a green checkmark) and "parseNegativeNumbers()" (marked with an orange 'x'). To the right of the tree view, the details for the failed test "parseNegativeNumbers()" are displayed, showing the error message: "java.lang.AssertionError: Expected: a value less than <0> but: <2> was greater than <0>".

Test Name	Duration	Status
sweng (ch.epfl)	16 ms	Failed
ParserTests	16 ms	Failed
parsePositiveNumbers()		Passed
parseNegativeNumbers()	16 ms	Failed

Tests failed: 1, passed: 1 of 2 tests – 16 ms

java.lang.AssertionError:
Expected: a value less than <0>
but: <2> was greater than <0>

Writing good tests

Test shape

- Arrange

“Given this situation...”

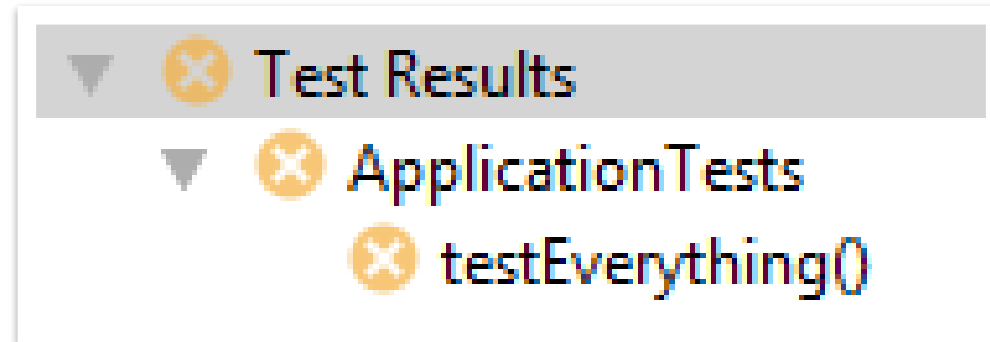
- Act

“When this happens...”

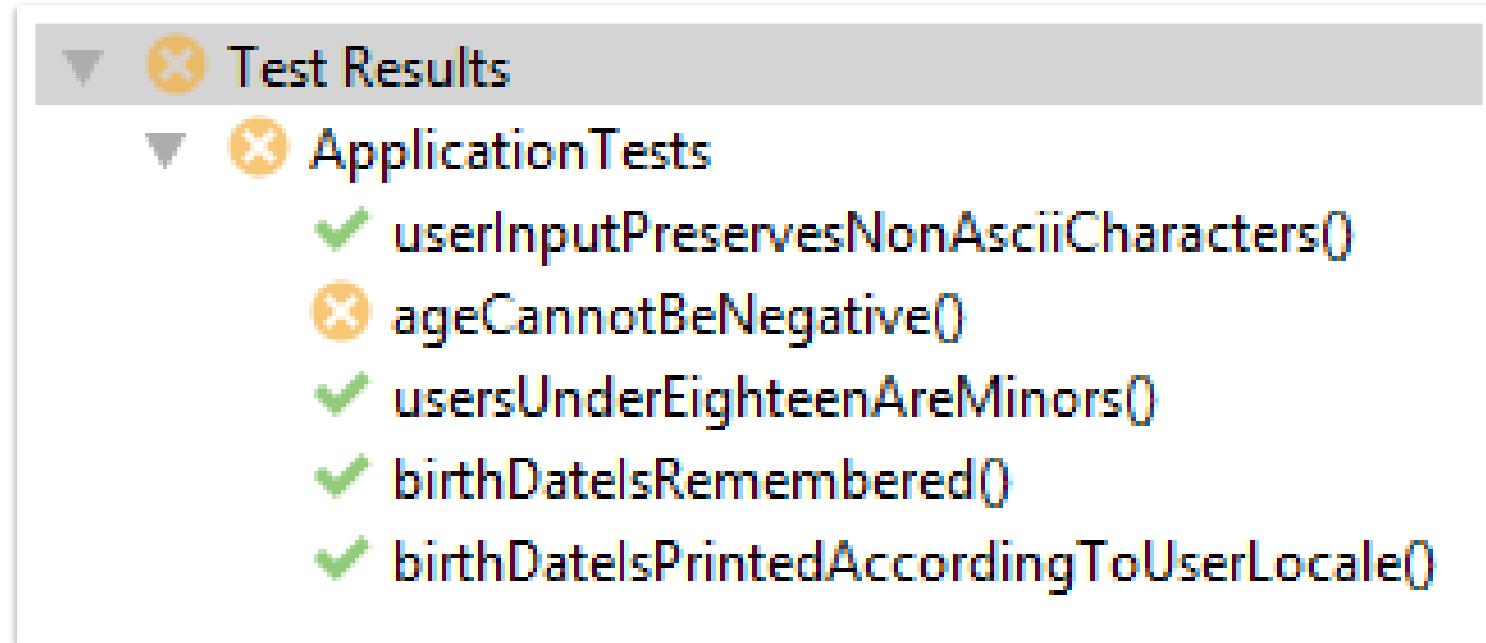
- Assert

“Then the outcome should be...”

Test size



Test size



Test code is code

- Also in repository
- Same standards
- Same quality level

Test names

- `birthDateIsPrintedCorrectly`
- `nameCanIncludeThaiCharacters`
- `shareFeatureWorks`
- `canParseNumbersAtLeastOneThousand`

Test names

- `birthDateIsPrintedCorrectly`
- `nameCanIncludeThaiCharacters`
- `shareFeatureWorks`
- `canParseNumbersAtLeastOneThousand`

Sharing test code

```
@BeforeAll static void globalSetup() { ... }
```

```
@AfterAll static void globalTeardown() { ... }
```

```
@BeforeEach void localSetup() { ... }
```

```
@AfterEach void localTeardown() { ... }
```

```
@Test ...
```