

How Novice Testers Perceive and Perform Unit Testing

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*Images from google.com



Guess:

How much (in USD) does the poor software quality cost the United States in 2022?

≥ \$2.41 trillion

https://www.it-cisq.org/the-cost-of-poor-quality-software-in-the-us-a-2022-report/

"Most of our new grad hires have limited experience with automated testing, and that's a daily activity at Google. Every change that you are going to make to the codebase is going to come with unit tests. That is the rule."

Titus Winters. "The Gap between Industry and CS Edu." ITiCSE 2022

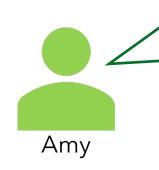
Purpose of Testing

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Purpose of Testing

- **Level 0** There is no difference between testing and debugging
- **Level 1** The purpose of testing is to show correctness
- Level 2 The purpose of testing is to show that the software does not work.
- Level 3 The purpose of testing is not to prove anything specific, but to reduce the risk of using the software.
- Level 4 Testing is a mental discipline that helps all IT professionals develop higher-quality software.

Representative Questions



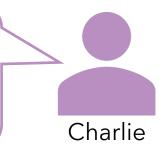
One of my tests failed, is it okay? Should I fix the test to make it pass? Does the failure indicate a bug in the source code? Or in my testing code?

I was wondering how many test cases do I need to write? Do I need to test everything? I've already found one bug in the code. When can I stop testing?

Bob

Representative Questions

I found some code examples on StackOverflow, but it's giving me a compile error, and I don't know how to fix it. Can I just delete it?



I found the bug, but I don't know how to show that in unit tests... Can I just describe it in comments?

Daniel

[Bai, Smith, Stolee. ITiCSE '21]

Challenges

- > Novices find it challenging to determine **what and how to test**.
- Novices have no consensus on good unit tests, and hence
 Novices find it challenging to determine when to stop testing,
 - Novices tend to only test happy paths.
- Novices often create test cases that **mismatch** the program specifications.

Novices face implementation barriers

Test Case Checklist

Each test case should:

- be executable (i.e., it has an @Test annotation and can be run via "Run as JUnit Test")
- have at least one assert statement or assert an exception is thrown. Example assert statements include: assertTrue, asse assertEquals (click for tutorials). For asserting an exception is thrown, there are different approaches: try{...; fail();} catc e){assertThat...;}, @Test(expected = exception.class) in JUnit 4, or assertThrows in JUnit 5 (click for tutorials).
- evaluate/test only one method

Each test case *could*:

- be descriptively named and commented
- □ If there is redundant setup code in multiple test cases, extract it into a common method (e.g., using @Before)
- If there are too many assert statements in a single test case (e.g., more than 5), you might split it up so each test evaluate behavior.

Test Suite Checklist

The test suite should:

- $\hfill\square$ have at least one test for each requirement
- appropriately use the setup and teardown code (e.g., @Before, which runs before each @Test)
- contain a fault-revealing test for each bug in the code (i.e., a test that fails)
- □ For each requirement, contain test cases for:
 - Valid inputs
 - Boundary cases
 - Invalid inputs
 - Expected exceptions

To improve the test suite, you could:

measure code coverage using an appropriate tool, such as EclEmma (installation, tutorial). Inspect uncovered code and w appropriate.

[Bai, Presler-Marshall, Price, Stolee. ITiCSE '22]

Testing Checklist



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Syntax and tutorials

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Test Class Components

Equivalence Class Partitioning

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Boundary Value Analysis

[Bai, Presler-Marshall, Price, Stolee. ITiCSE '22]

Testing Checklist

Contains Testing strategies Tutorial information

Test Case Checklist

Each test case should:

Syntax Errors

Poor Requirement Coverage

Misinterpretation of Failing Tests

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No Assertions

Each test case could:

Bad Naming

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 Assertion Roulette

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Testing Happy Path Only

Testing Checklist

[Bai, Presler-Marshall, Price, Stolee.

Addresses

ITICSE '22]

- **Common mistakes**
- Common test smells

Effectiveness

Our study shows that...

The lightweight testing checklist is at least as effective as a coverage tool, e.g., EclEmma, for writing quality tests.

Novices who have lower prior knowledge of unit testing may benefit more from the checklist

[Bai, Presler-Marshall, Price, Stolee. ITiCSE '22]

Takeaways

Most novices see no difference between testing and debugging, and many of them believe the goal of testing is to show correctness.

Novices face various challenges when performing testing.

The tool support does not need to be sophisticated to be effective.