Intro to Software Testing

chapter 4

Agile Testing

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https://go.gmu.edu/SWE637
Adapted from slides by Jeff Offutt and Bob Kurtz
Traditional Testing

Driven by up-front analysis and modeling

We know that it’s less expensive to find and fix problems early in the software lifecycle

Software Engineering Institute; Carnegie Mellon University; Handbook CMU/SEI-96-HB-002
Traditional Testing Assumptions

Analysis and modeling can identify potential problems early in development

• …assuming the requirements are complete and unchanging, and how often does that happen? *(Hint: never)*

• In general, the waterfall model of software development is broken
How to write good code

HOW TO WRITE GOOD CODE:

START PROJECT.

DO THINGS RIGHT OR DO THEM FAST?

FAST

RIGHT

CODE WELL

DOES IT WORK YET?

NO

NO, AND THE REQUIREMENTS HAVE CHANGED.

THROW IT ALL OUT AND START OVER.

ALMOST, BUT IT'S BECOME A MASS OF KLUGES AND SPAGHETTI CODE.

GOOD CODE
Agile Development

Agile methods start by realizing that:

• engineers (and customers) are not good at developing requirements
• we don’t anticipate the changes that we’ll need, and often don’t need the changes that we anticipate
• requirements get out of date quickly and may change continuously

In agile development, we start small and evolve over time
The Agile Manifesto

We are uncovering better ways of developing software by doing it and helping others do it. Through this work we have come to value:

- **Individuals and interactions** over processes and tools
- **Working software** over comprehensive documentation
- **Customer collaboration** over contract negotiation
- **Responding to change** over following a plan

That is, while there is value in the items on the right, we value the items on the left more.

[https://agilemanifesto.org](https://agilemanifesto.org)
According to Dilbert...

WE’RE GOING TO TRY SOMETHING CALLED AGILE PROGRAMMING.

THAT MEANS NO MORE PLANNING AND NO MORE DOCUMENTATION. JUST START WRITING CODE AND COMPLAINING.

I’M GLAD IT HAS A NAME. THAT WAS YOUR TRAINING.
The Test Harness as Guardian

Traditional correctness is *universal*  

\[ \begin{align*}  
x, y, x & \geq y 
\end{align*} \]

Agile correctness is *existential*

\[\begin{align*}  
\{ & (1, 1) \square T \\
& (1, 0) \square T \\
& (0, 1) \square F \\
& (10, 5) \square T \\
& (10, 12) \square F \} 
\end{align*} \]
Continuous Integration (CI)

Agile methods work best when tests can be run against the current version of the software at any time (or all the time)

- Mistakes are caught earlier
- The value of tests is amplified by running them frequently

A continuous integration server (like Jenkins) rebuilds the system and reverifies test results whenever updates are checked in to the source code repository

A continuous Integration system doesn't just run tests, it decides if the modified system is still correct
CI Reduces Risk

With continuous integration you are never very far away from a working, fully-tested system.
Test Driven Development

TDD is a method for developing low-level tests before implementing the software

• A test is written based on a feature derived from a requirement or a user story, then just enough code is written to satisfy the test

The core principle is “you ain't gonna need it!” (YAGNI)

• Don’t build software until you’re sure it’s necessary for the desired functionality
• Reduces scope creep and software size, which in turn reduces the number of faults
Test Driven Development

1. Identify feature
2. Implement unit test
   - Test fails?
     - NO: Implement code
     - YES: Test pass?
       - NO: Test pass?
         - NO: Refactor code
         - YES: Enough tests?
           - NO: Refactor
           - YES: Done
       - YES: Test pass?
         - NO: Enough tests?
           - NO: Refactor code
           - YES: Done
   - YES: Done

We can apply test criteria here
Refactoring

“Refactoring consists of improving the internal structure of an existing program’s source code, while preserving its external behavior.”

– Agile Alliance, www.agilealliance.org

Why refactor?

- Improve code attributes like size, duplication, complexity; improve performance and maintainability
- Reduces code smells and technical debt

If you have a strong set of unit tests, you can refactor without fear.
Testing Legacy Systems

Much of today’s software is *legacy*

- Often lacks up-to-date (or any) tests
- Legacy requirements may be outdated
- Design documentation, if there ever was any, is probably lost
- The only source of information is the code itself

Companies often choose not to change legacy software due to fear of failure

- Writing tests for millions of lines of legacy software is too expensive

**We can’t write full tests, but we can’t just give up either… what can we really do?**
Incremental TDD

When a change is made, use TDD to write tests just for that change

Refactor the changed code to improve its structure and maintainability

As the project continues, the collection of tests grows, until eventually a substantial part of the system will have strong tests
The Testing Shortfall

Do TDD/ATDD tests test the software thoroughly?
  • Do the tests achieve good coverage?
  • Do the tests find most of the faults?
  • If the tests pass, should we feel confident that the software is reliable?

Maybe not...
The Testing Shortfall

Most agile tests focus on “happy paths”
- Things that happen during normal use
- “Normal” use cases

They miss things like
- Things that confused users might do
- Things that creative users might do
- Things that malicious users might do
How to design better tests

Human-based approach

• Create additional user stories that describe exceptional paths
• This is an intuitive process that’s hard to teach
• It’s hard to know when you’re finished

Modeling and criteria

• Model the input domain
• Model the software behavior with graphs, logic, or grammars
• It’s a discrete process
• Built-in notion of completion

This is part 2 of the textbook.