

Application Testing

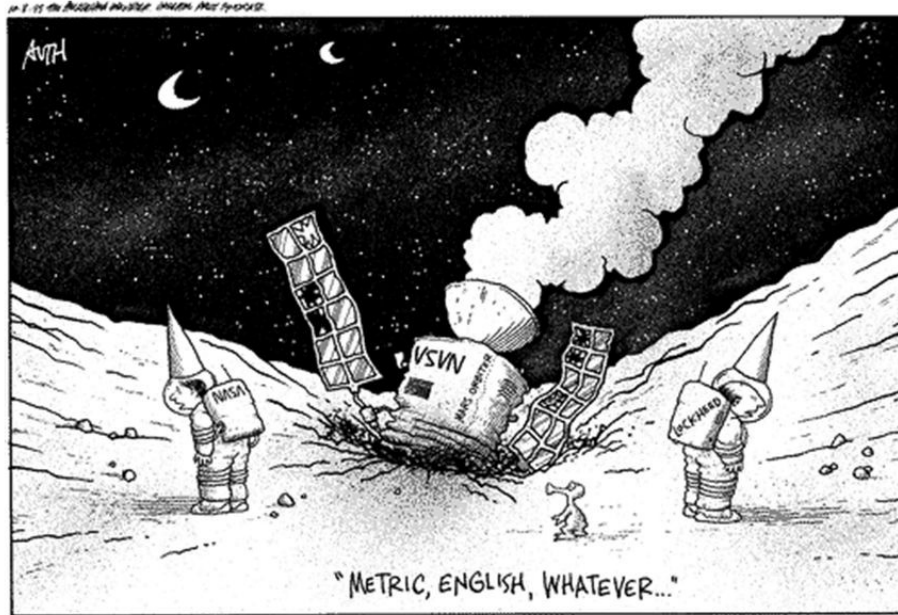
Professorship of Open Source Software
Friedrich-Alexander University Erlangen-Nürnberg

ADAP B03

Licensed under [CC BY 4.0 International](#)

Software Defects

- Software is omnipresent in our daily life
- Bugs and errors in software can have grave consequences



Remember the Mars Climate Orbiter incident from 1999?

<https://slideplayer.com/slide/5829764/19/images/37/Remember+the+Mars+Climate+Orbiter+incident+from+1999.jpg>

FEHLER IN DER SOFTWARE

Zehntausenden Studenten droht Bafög-Verspätung

AKTUALISIERT AM 24.08.2016 - 16:08



Seit dem ersten August gibt es höhere Bafög-Sätze und Freibeträge. Doch eine gängige Bearbeitungs-Software kennt diese Neuerungen nicht. Deshalb könnten viele Studenten zum Semesterstart erst einmal ganz ohne Geld dastehen.

<https://www.faz.net/aktuell/karriere-hochschule/campus/fehler-in-der-software-zehntausenden-studenten-droht-bafoeg-verspaetung-14403776.html>

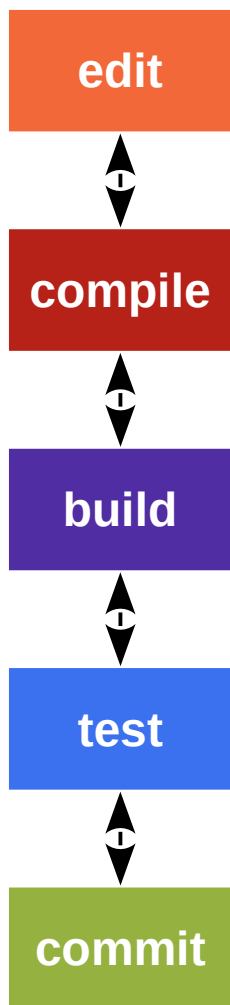
Advanced Design and Programming

© 2022 Riehle & FAU - Some Rights Reserved

Why Testing Anyway?

- Find failures and defects and prevent them reaching the production version
- Check if item under test works as one expects
- Reduce level of risk of inadequate software quality
- Check if requirements have been satisfied
- Gain confidence in the quality of the item under test
- Comply with legal or contractual requirements or standards

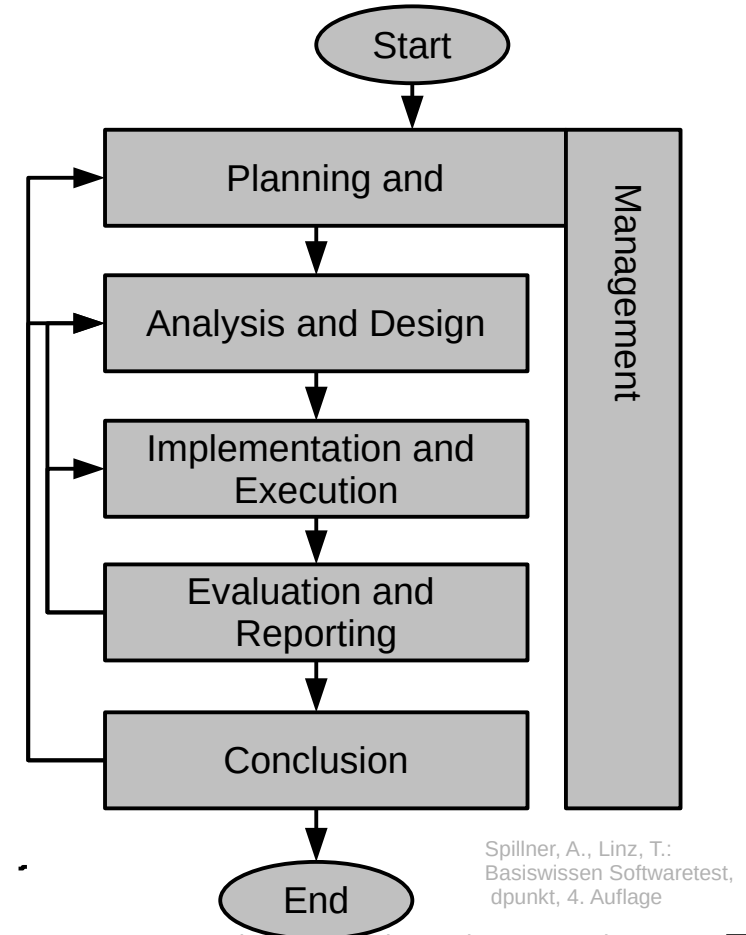
Simple Development Cycle



- **Edit** = developer implements new feature
 - Iterates over the code until it looks right
- **Compile** = developer compiles the code
 - Iterates over the code until it compiles (no syntax error)
- **Build** = developer puts classes, build path together
 - Packages application
- **Test** = developer tests the program
 - Keeps going until “behavior looks right” i.e. no bugs
- **Commit** = developer commits to code repository
 - May trigger a CI pipeline

Testing is a Process

- In larger projects testing needs to be governed by a process
 - Planning and managing the test process
 - Analysing which tests are necessary and designing them
 - Implementing the tests and executing them
 - Evaluation of test results and reporting
 - Learn for the future



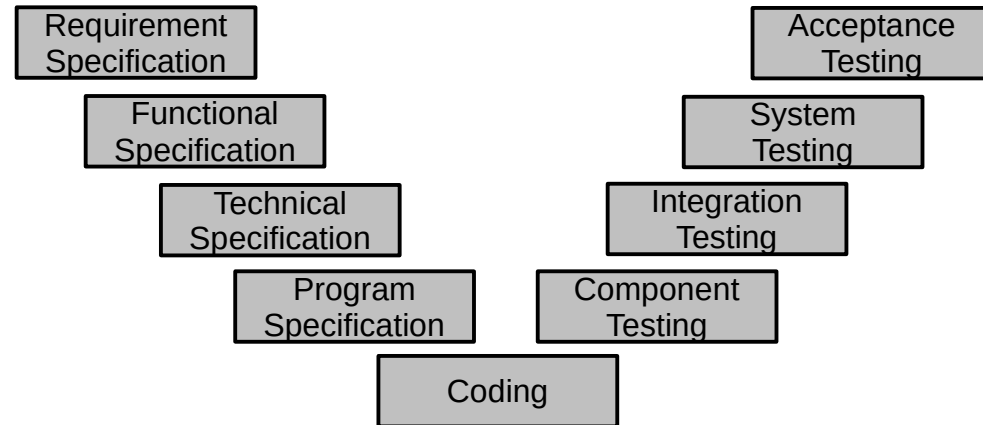
Spillner, A., Linz, T.:
Basiswissen Softwaretest,
dpunkt, 4. Auflage

Static vs. Dynamic Testing

- **Static testing**
 - No execution of the software necessary
 - Static code analysis
 - Reviews
 - of code
 - of diagrams
 - of documents, e.g. requirement specification
- **Dynamic Testing**
 - Testing at run-time of a software

Test Levels

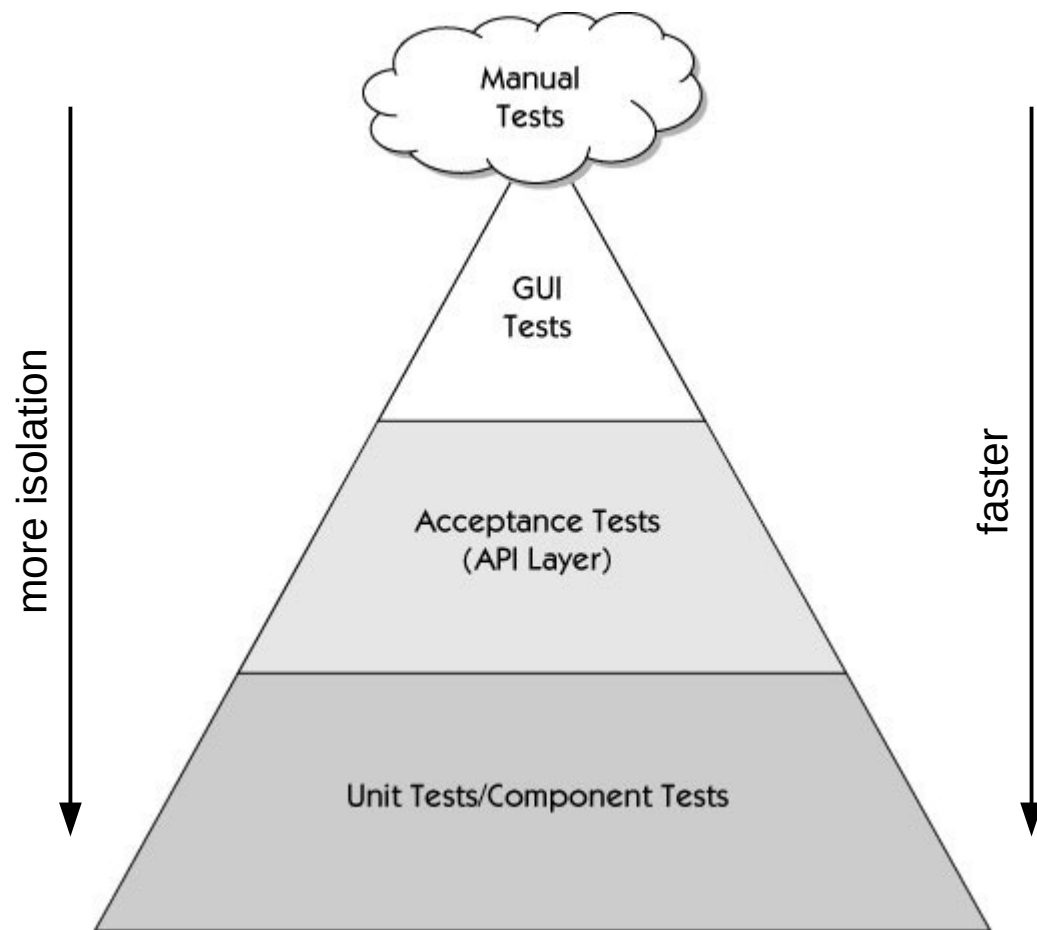
- **Components tests** (a.k.a. unit tests)
 - Focus on testing one component out of context
- **Integration tests**
 - Focus on the collaboration of different components
- **System tests**
 - Focus on the system as a whole
- **Acceptance tests**
 - Focus on customer and end user experience



Test Types

- **Functional testing (a.k.a. Blackbox Testing)**
 - Tests against functional requirements
 - Tests the behaviour that is visible to the outside world
- **Non-functional testing**
 - Tests against non-functional requirements
 - E.g. performance, stress, usability, portability requirements
- **Structure-based testing (a.k.a. Whitebox Testing)**
 - Tests against internal structure of component or system
 - Goal is to cover all elements of the spectated structure
- **Testing related to changes**
 - Retests after a bug was fixed to ensure the fix
 - Regression testing after any changes on the software

Test Automation Pyramid



- Try to automate as much as possible
- Manual testing
 - takes time that can be saved by automation
 - is not as reliable as programmed tests
 - tends to be selective, not comprehensive
- But:
 - Human intuition can see problems that computers cannot
 - Some things can't be automated
 - e.g. usability tests

7 Software Testing Principles

1) Testing shows the presence of defects

- “Program testing can be used to show the presence of bugs, but never to show their absence!” – Edsger W. Dijkstra, 1970

2) Exhaustive testing is not possible

- E.g. input field for emails: can we test each input?

3) Start testing early

- The earlier we find defects (e.g. in the requirement analysis phasis) the less the costs for fixing them

4) Testing is context-dependent

- Safety-critical systems are differently tested than apps!

5) Defect clustering

- Pareto principle: 80% of problems are found in 20% of the modules

6) Pesticide paradoxon

- Just retrying tests has no benefits. Test cases have to be reviewed and revised.

7) Absence of error

- If tests find no defects, there still might be some in the system!

Testing Terminology

- **Test (Case)**
 - A single test for some particular aspect of the software, succeeds or fails
- **Test Suite**
 - A set of related tests that cover a particular domain of the software
- **Test Set-up**
 - The data and preparation necessary to run a test as intended
- **Test Result**
 - The result of running a test, typically succeeds/fails or error
- **Test Harness**
 - A software, like JUnit, that is used to run test suites

Thank you! Questions?

dirk.riehle@fau.de – <https://oss.cs.fau.de>

dirk@riehle.org – <https://dirkriehle.com> – [@dirkriehle](#)

Legal Notices

- License
 - Licensed under the **CC BY 4.0 International** License
- Copyright
 - © 2012-2021 Dirk Riehle, some rights reserved
 - © 2019-2021 Friedrich-Alexander University Erlangen-Nürnberg, some rights reserved
- Credits
 - Georg Schwarz (2019)