

# Application Testing

**Prof. Dr. Dirk Riehle**

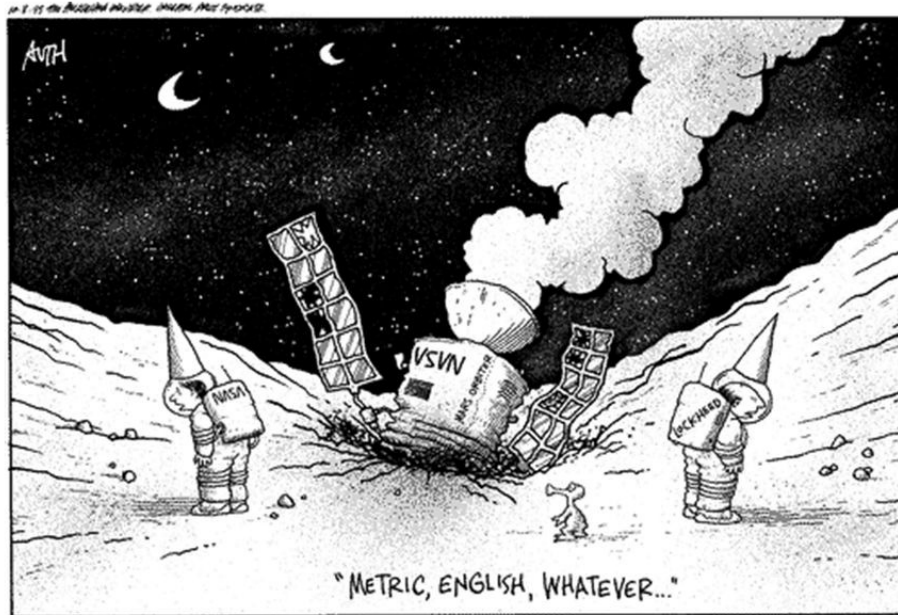
**Friedrich-Alexander University Erlangen-Nürnberg**

**ADAP Y01**

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# 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?**

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FEHLER IN DER SOFTWARE

## Zehntausenden Studenten droht Bafög-Verspätung

AKTUALISIERT AM 24.08.2016 - 16:08



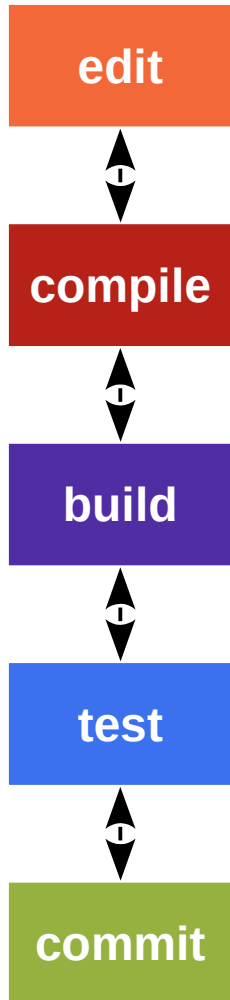
Seit dem ersten August gibt es höhere Bafög-Sätze und Freibeträge. Doch eine gängige Bearbeitungs-Software kennt diese Neuerungen nicht. Deshalb könnten viele Studenten zum Semesterstart erst einmal ganz ohne Geld dastehen.

<https://www.faz.net/aktuell/karriere-hochschule/campus/fehler-in-der-software-zehntausenden-studenten-droht-bafoeg-verspaetung-14403775.html>

# 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

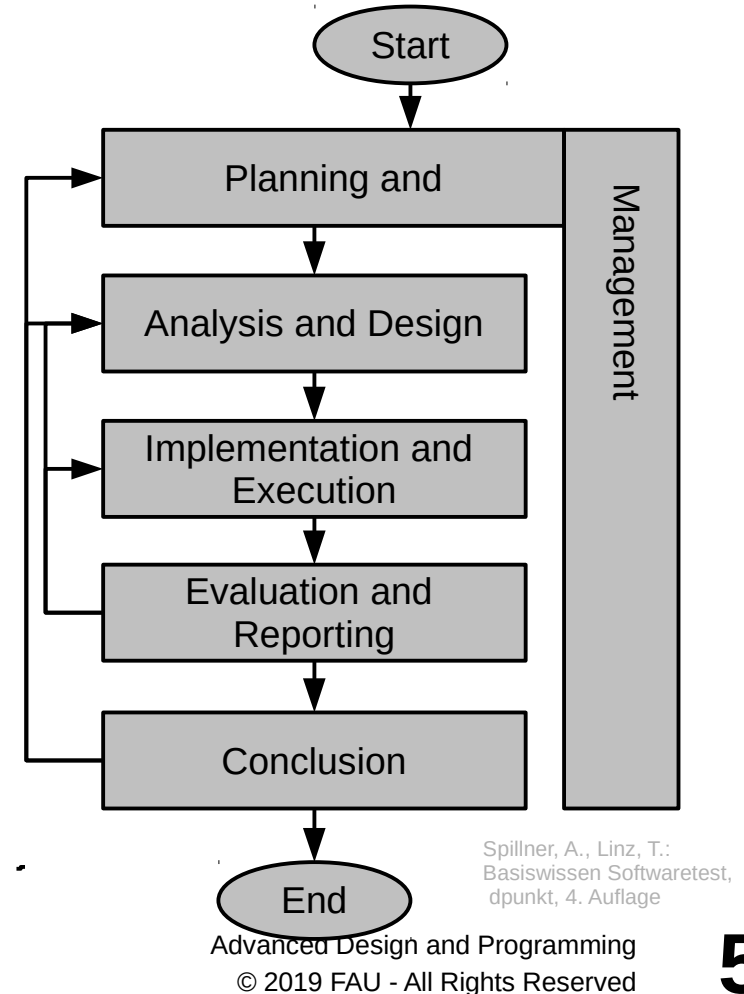
# Simple Development Cycle



- **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

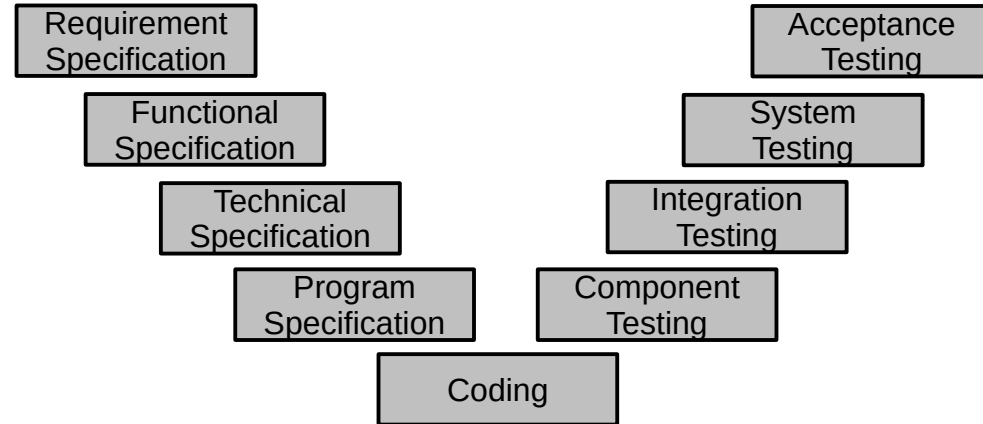


# Static vs. Dynamic Testing

- **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

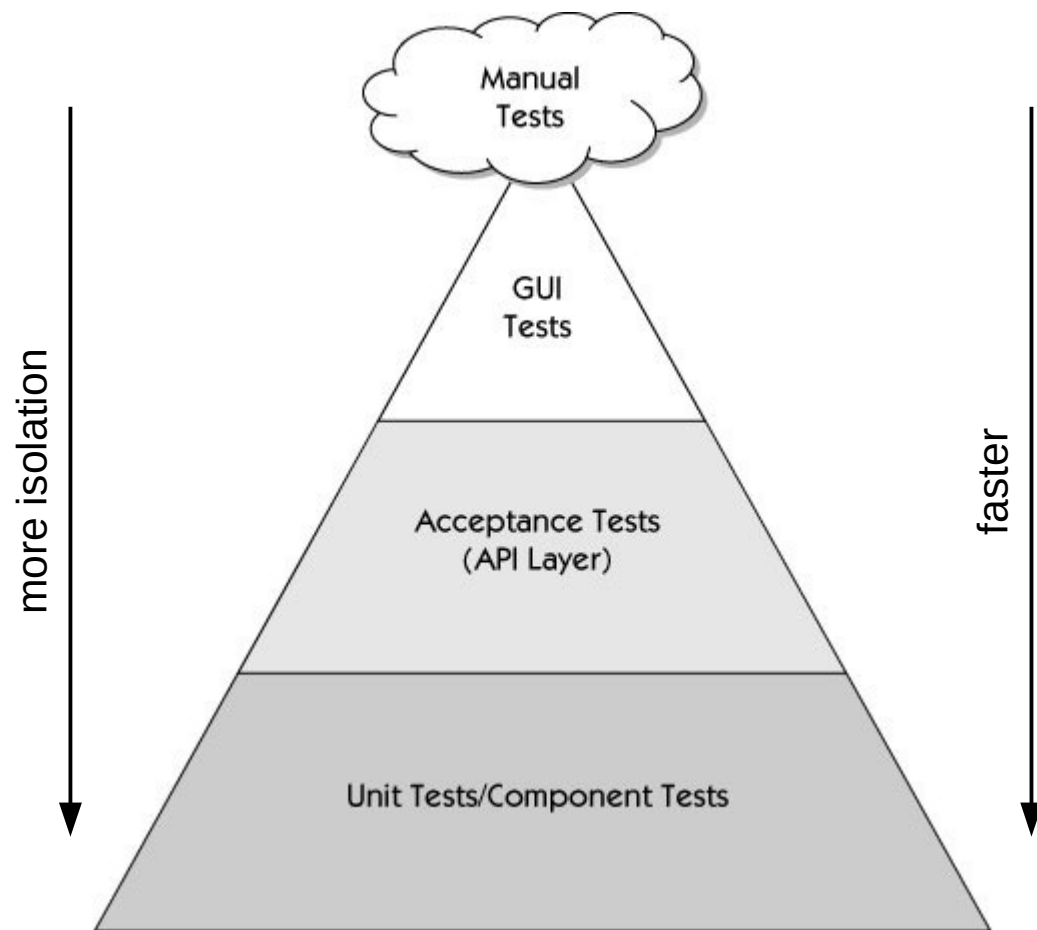
- **Components tests** (a.k.a. unit tests)
  - Focus on testing one component out of context
- **Integration tests**
  - Focus on the collaboration of different components
- **System tests**
  - Focus on the system as a whole
- **Acceptance tests**
  - Focus on customer and end user experience



- **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?

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- Contributions
  - Georg Schwarz (2019)

# Application Testing

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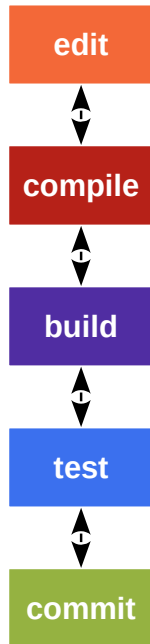
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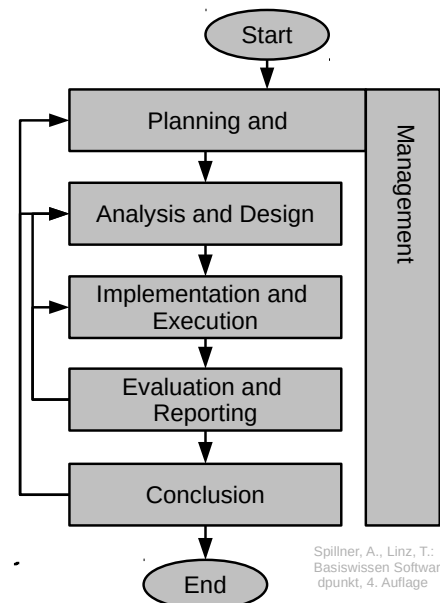
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Spillner, A., Linz, T.:  
Basiswissen Softwaretest,  
dpunkt, 4. Auflage

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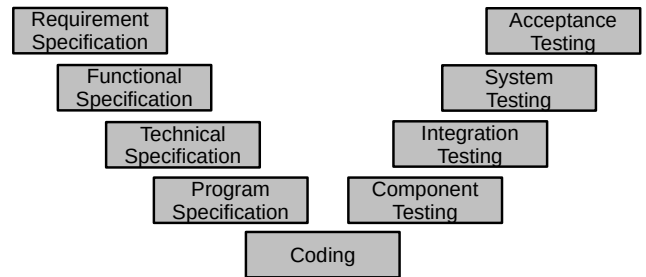
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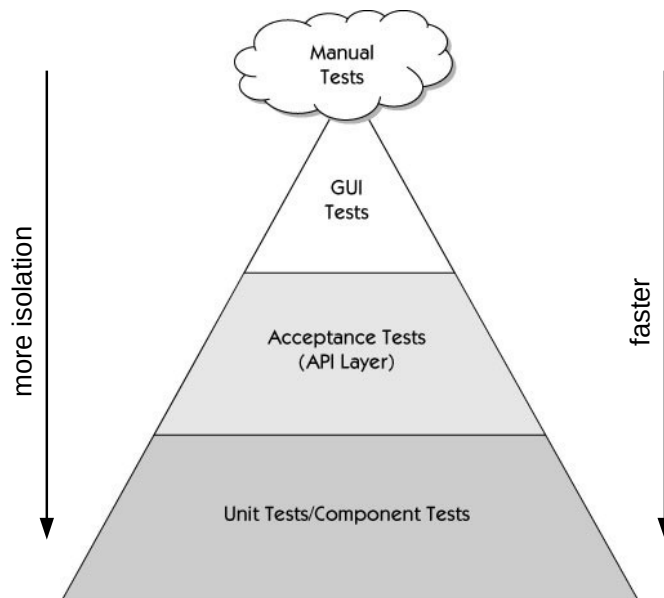
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Janet Gregory, Lisa Crispin: Agile Testing – A Practical Guide for Testers and Agile Teams (2008)

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