

Agile Quality Assurance

Prof. Dr. Dirk Riehle

Friedrich-Alexander University Erlangen-Nürnberg

AMOS F01

Licensed under [CC BY 4.0 International](#)

Agenda

1. Test-first programming
2. Test-driven development
3. Pair programming
4. Pre-commit code review
5. Build management
6. Continuous integration
7. Continuous delivery

1. Test-First Programming

- 1. Tests and testing**
- 2. Test-first programming**
- 3. Test-driven development**

Tests and Testing

- Testing is a process
 - that tests some concern (the concern “under test”)
 - for correct and expected operation
 - according to a specification
 - usually as part of quality assurance
- Tests can be manual or automated
- Tests verify against a given specification
- Tests increase confidence in correct functioning
- However, tests can never proof a program correct

Types of Tests [1]

- **Components tests** (a.k.a. unit tests)
 - Focus on testing one component out of context
- **Acceptance tests** (a.k.a. functional tests)
 - Focus on testing one cross-cutting functionality
- **Integration tests** (a.k.a. system tests)
 - Focus on testing end-to-end system integrity

[1] This is a simplification for the purposes of this course.

Tests and 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, either succeed or fail, or a test error
- **Test harness (framework)**
 - A software, like JUnit, that is used to simplify the implementation of tests

Test-First Programming [B02]

- Test-first programming is a practice in which developers
 - Write a test before they implement the actual functionality and
 - Iterate over an “add new or enhance test, make test work” loop
- Functionality is a by-product of making the tests work
 - Test-first programming
 - clarifies code functionality and interfaces
 - improves code quality through second use scenario
 - builds up test suite for continuous integration (later)

**Only write new code
when a test fails**

Then, eliminate waste

1. **Red**
2. **Green**
3. **Refactor**

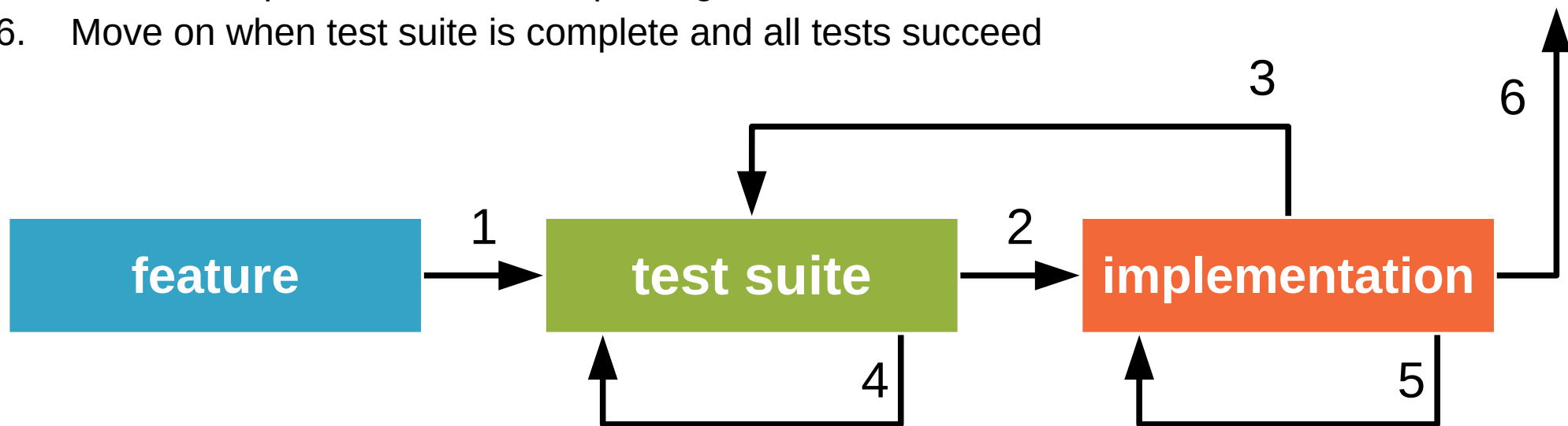
2. Test-Driven Development

Test-Driven Development (TDD) 1 / 3

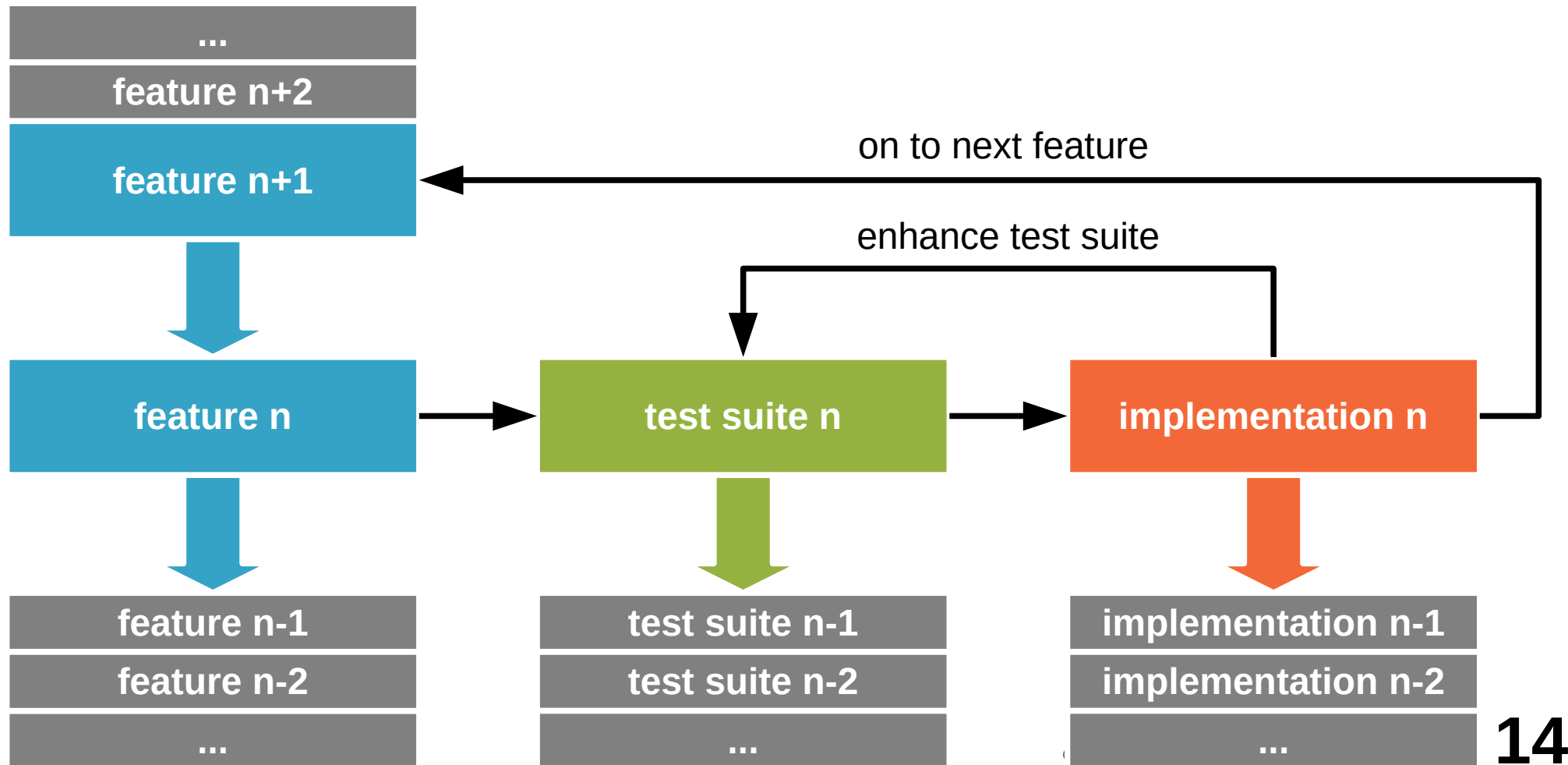
- Test-driven development
 - Is a minimal development process based on test-first programming
 - Turns feature requests into implementations
- Purpose of test-driven development
 - To grow the product incrementally and steadily
 - To be able to release after every feature implementation

Test-Driven Development 2 / 3

1. Translate partial or full feature description into test suite
2. Implement feature to fulfill (“green-bar”) test suite
3. Revise test suite from new insights
4. Refactor test suite to keep design and code clean
5. Refactor implementation to keep design and code clean
6. Move on when test suite is complete and all tests succeed



Test-Driven Development 3 / 3



3. Pair Programming

- Definition and purpose
 - “Code review is systematic examination [...] of computer source code.
 - It is intended to find and fix mistakes overlooked in the initial development phase,
 - improving both the overall quality of software
 - and the developers’ skills.
 - Reviews are done in various forms such as
 - pair programming,
 - informal walkthroughs, and
 - formal inspections.” [1]

[1] Adapted from https://en.wikipedia.org/wiki/Code_review

When to Review Code?

- 1. In the moment**
- 2. Before commit**
3. At another time
4. Before release

- 1. Pair programming**
- 2. Pre-commit code review**

Pair Programming

- Definition
 - Is programming carried out by pairs of programmers
 - One programmer implements, and the other programmer reviews
 - Effectiveness is debated; empirical studies show conflicting evidence
- Purpose
 - Quality assurance
 - Collaborative learning
 - Knowledge sharing
- Synonyms
 - Programmer and reviewer
 - Driver and co-driver
 - Pilot and navigator

Pair Programming (Practices)

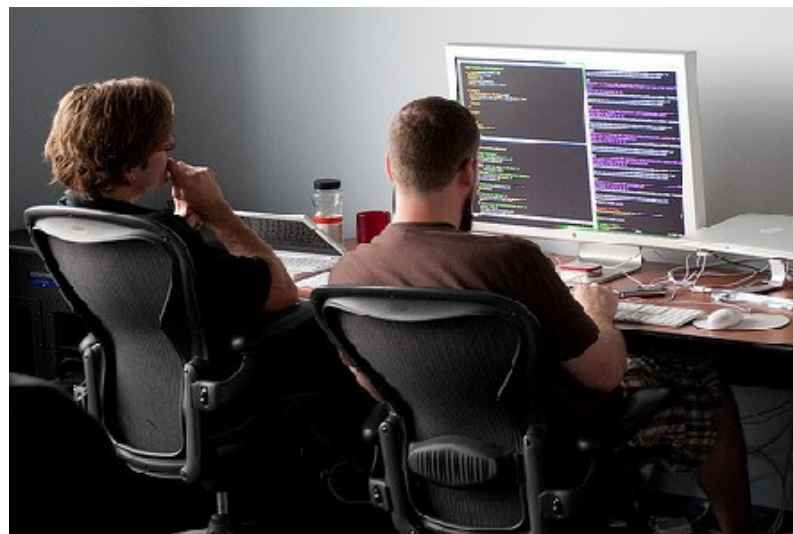
- **Process**

- Find comfortable partner
- Switch roles often
- Communicate regularly

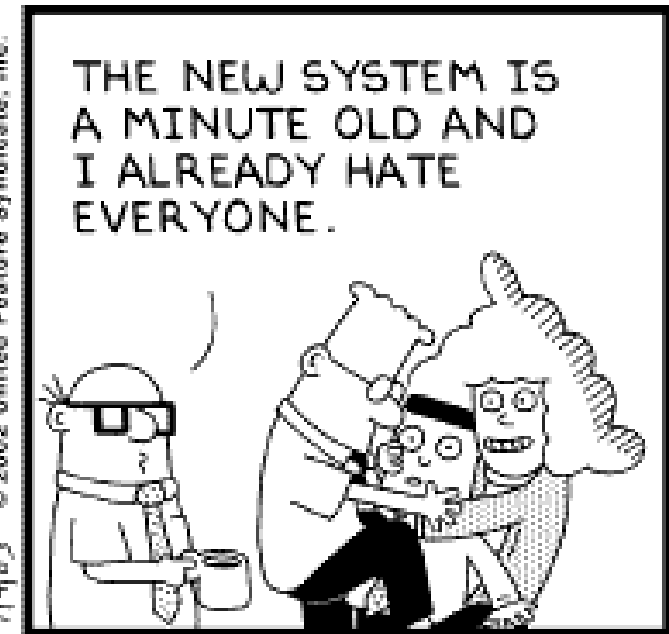


- **Advice**

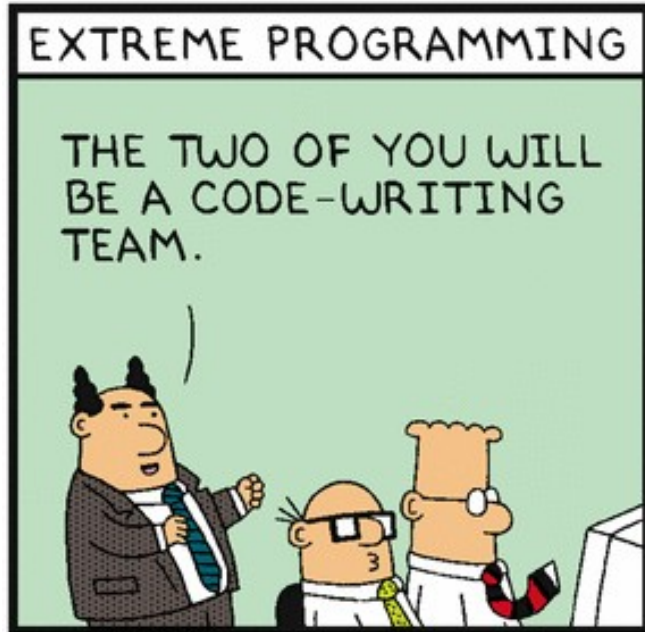
- Don't force it for small stuff
- Don't overheat, take a break
- Switch partners at times



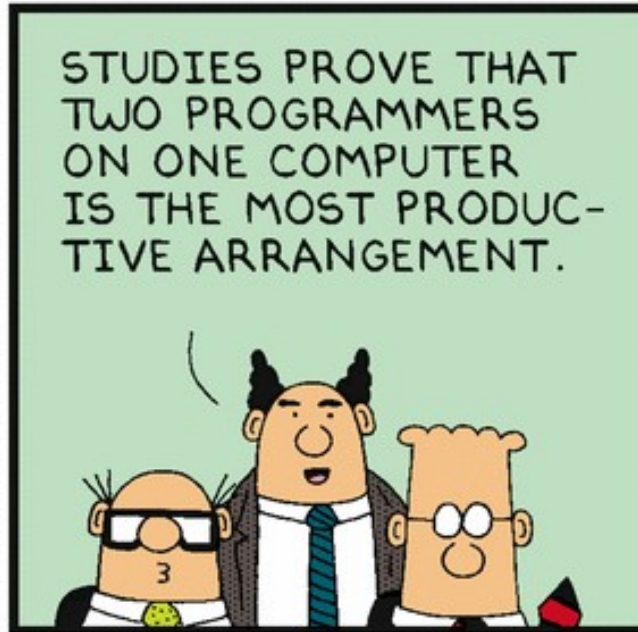
Dilbert on Pair Programming 1 / 2



Dilbert on Pair Programming 2 / 2



www.dilbert.com
scottadams@aol.com



1/11/03 © 2002 United Feature Syndicate, Inc.



4. Pre-Commit Code Review

Pre-Commit Code Review

- Code review
 - Is the (peer) review of source code for quality criteria
 - Reviewer has accept or reject responsibility
 - Cf. “Vier-Augen-Prinzip” (in German)
- Pre-commit code review
 - Is the review of source code before it gets committed to a team repository
 - Typically facilitated by a software tool, e.g. Gerrit
 - May lead to back and forth between developers until “LGTM”

Example Code Review with Gerrit

The screenshot shows the Gerrit Code Review interface for a change set. The top navigation bar includes 'All', 'Projects', 'Documentation', and 'Abandoned'. The main content area displays the change set details, including the commit message, author, and patch set. The patch set is titled 'Patch Set 2' and shows a diff for 'Example.body.php'. The diff shows a single line change: '1 comment'. The bottom section shows the 'Cover Message' field, which is currently empty.

The screenshot shows the Gerrit Code Review interface for a code diff. The top navigation bar includes 'All', 'Differences', 'Projects', 'Documentation', 'Patch Sets', and 'Files'. The main content area displays the code diff for 'Example.body.php'. The diff shows a single line change: '1 comment'. The code is displayed in a side-by-side view, with the left side showing the original code and the right side showing the patched code. The diff highlights the changes in green.

[1] See <https://www.mediawiki.org/wiki/Gerrit/Tutorial>

Example Code Review in Distributed Work (Merge Requests)

The screenshot shows a GitHub Pull Request interface for the repository 'dirkriehle / wahlzeit'. The pull request is titled 'Basic vue UI #133' and is created by 'Henny022'. It shows 5 commits being merged into the 'wahlzeit-40-new-ui' branch from the 'basic-vue-ui' branch. The pull request has 13,651 additions and 0 deletions. The commit history includes: 'added base vue app', 'added bootstrap', 'first mock pages', 'login and (very simple) photo viewing', and 'uploading of photos'. The pull request is marked as 'ready for review' by 'dirkriehle'. A status bar at the bottom indicates 'All checks have passed' with 1 successful check. The right sidebar shows sections for Reviewers, Assignees, Labels, Projects, Milestone, and Linked issues, all of which are currently empty or show 'None yet'.

dirkriehle / wahlzeit

Unwatch 3 Star 5 Fork 291

<> Code 34 Issues 34 Pull requests 1 Actions Projects 1 Security Insights Settings

Basic vue UI #133

Edit Open with

Open Henny022 wants to merge 5 commits into dirkriehle:wahlzeit-40-new-ui from Henny022:basic-vue-ui

Conversation 0 Commits 5 Checks 0 Files changed 20 +13,651 -0

Henny022 commented 6 days ago First-time contributor

This is based on the new backend by @knusperkrone

Henny022 added 5 commits 12 days ago

- added base vue app 69380b6
- added bootstrap 24a4adc
- first mock pages b50f9b6
- login and (very simple) photo viewing e300c37
- uploading of photos 2cedb9f

dirkriehle marked this pull request as ready for review now

Add more commits by pushing to the basic-vue-ui branch on Henny022/wahlzeit.

All checks have passed 1 successful check Show all checks

Reviewers: No reviews. Still in progress? Convert to draft.

Assignees: No one—assign yourself.

Labels: None yet.

Projects: None yet.

Milestone: No milestone.

Linked issues: Successfully merging this pull request may close these issues. None yet.

Benefits of Pre-commit Code Review

- Collaboration
 - Improves knowledge sharing and teamwork
 - Makes it easier to establish topics like security
- Quality assurance
 - Leads to more disciplined developers
 - Prevents (some) errors before they happen
 - Raises overall quality standards
- Feeling of responsibility
 - Specifically, supports collective code ownership
 - Strengthens overall feeling of responsibility

Agile vs. Open Source Code Review

- **Agile methods**

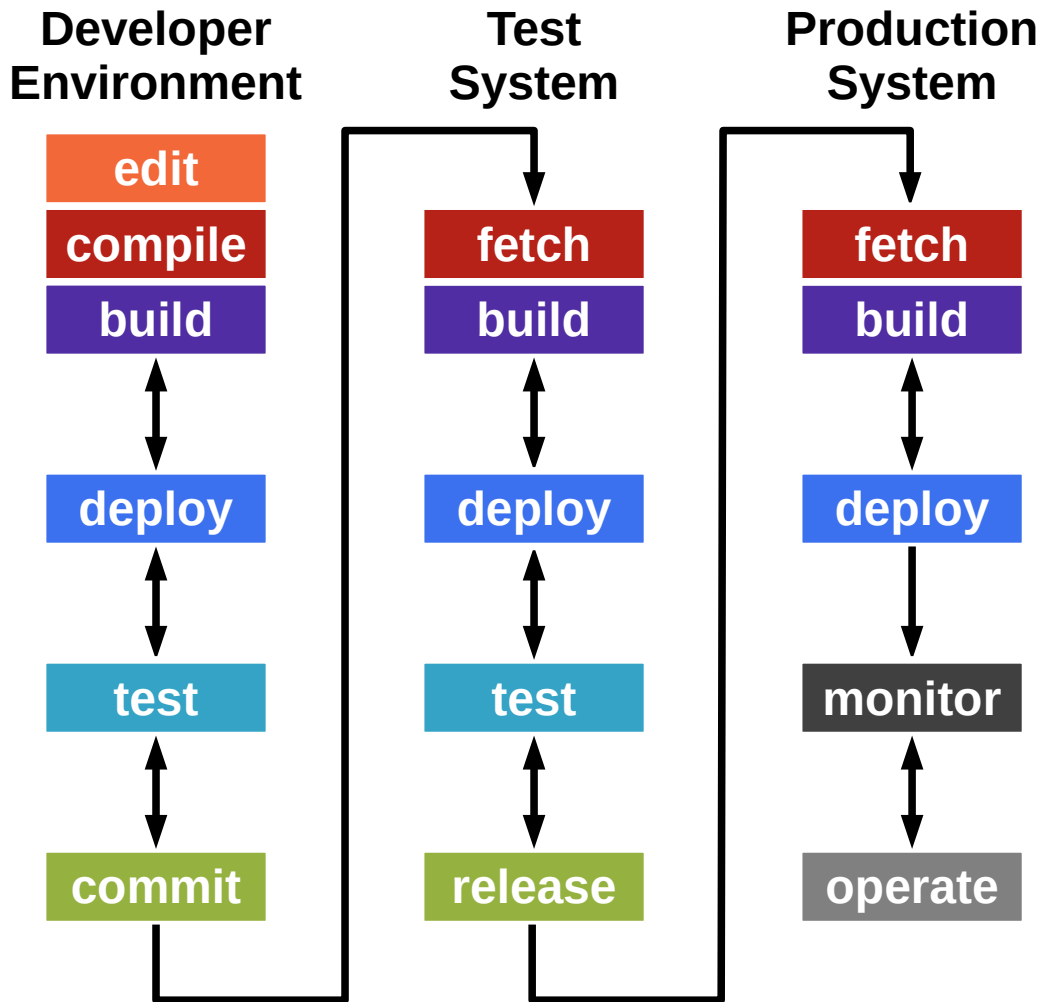
- Programming guidelines
 - Code reading >> writing
 - Make it easy to get acquainted
- Collective code ownership
 - Feature-oriented development
 - Typically co-located development
 - Everyone has write access
- Pair programming
 - Changes are reviewed directly
 - Everyone is a peer

- **Open source**

- Programming guidelines
 - Code reading >> writing
 - Showing respect for project
- Individual code ownership
 - Component-oriented development
 - Typically distributed development
 - Strictly regulated write access
- Patch review
 - Changes are submitted for review
 - Two-class reviewing hierarchy

5. Build Management

Professional Development Cycle



- QA engineer
 - Fetches code
 - Builds full system
 - Deploys in test system
 - Tests full system
 - Automated and by-hand
 - Component tests
 - Acceptance
 - Integration tests
 - Deploys full system
 - Operates system

Build Process

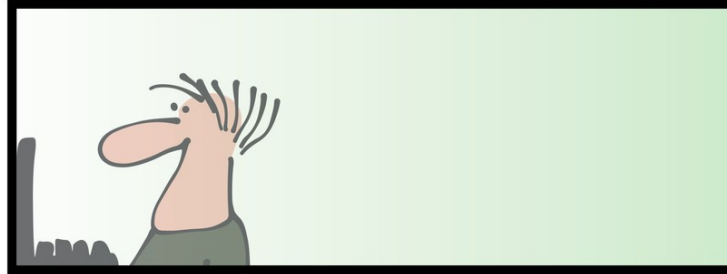
- Definition
 - Is the defined and (ideally automated) process of deriving an installable product from its source artifacts
- Purpose
 - Defines a standard environment
 - Provides developers with setup
 - Defines clear commit rules
 - Manages test data etc.

Developer Responsibilities

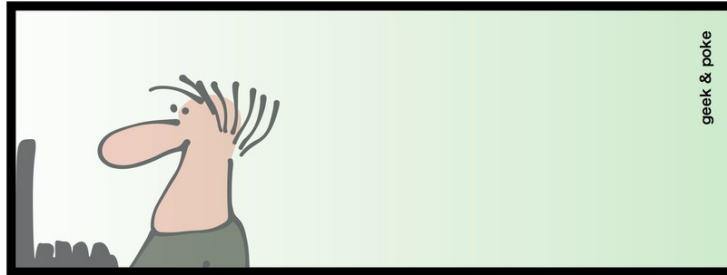
- Only work in defined standardized environment
 - This ensures no subtle differences to central build process
- Only commit / push code that compiles and works
 - “Breaking the build” through non-compiling code hurts team
- Only commit / push code that passes all the tests
 - Failing tests quickly degenerate system (hard to catch-up)

DEVELOPMENT CYCLE

FRIDAY EVENING EDITION



COMMIT



PUSH



RUN

Build Asset Management

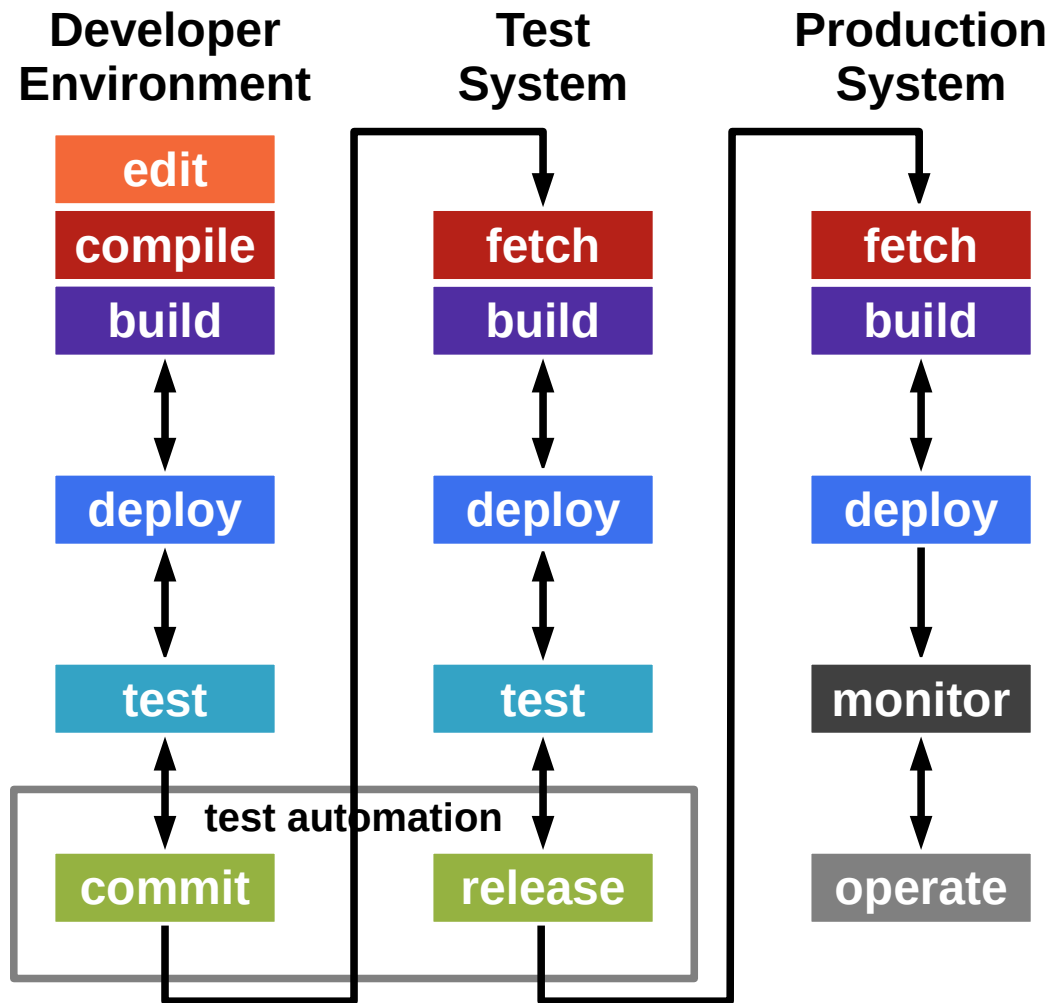
- Management by hand
 - Libraries are curated by hand
- Automated management
 - Libraries are pulled in automatically
- Bill of materials
 - Possibly generated automatically

Quiz: Supply Chain Effects

- Last week you delivered your product release to your client. The phone rings and an angry client is on the line, complaining about missing their schedule. What might have gone wrong?
 1. The client's development team objected
 2. The client's quality assurance unit objected
 3. The client's legal team objected
 4. All of the above

6. Continuous Integration

Continuous Integration Development Cycle



- Release (QA) engineer
 - Fetches code
 - Builds full system
 - Deploys in test system
 - Tests full system
 - Automated and by-hand
 - Component tests
 - Acceptance
 - Integration tests
 - Deploys full system
 - Operates system

Test Automation

- Test automation ...
 - automatically carries out all available tests
 - Component tests (unit tests)
 - Acceptance tests (functional tests)
 - Integration tests and system tests
 - provides feedback to development and QA

Continuous Integration

- Continuous integration (CI) is a code integration process
 - Upon trigger (commit to official repository)
 - the system under construction is fetched, built, deployed, and tested
 - in a fully automated way (no human intervention)
 - Feedback upon system status is provided to both
 - developers and
 - managers
- The purpose of continuous integration is to
 - always know where you are standing with respect to the project
 - ideally improve quality such that you can deploy at any time
- Continuous integration requires test-driven development

Continuous Integration and Lava Lamps



In the early days, lava lamps were used to signal whether the project could be deployed to production or not.

Continuous Integration Dashboards



Continuous integration quickly evolved to build and test status dashboards hung on office walls for everyone to see.

Example CI Dashboard (Jenkins)

Back to Project

Status

Changes

Console Output [raw]

View Build Information

Polling Log

Test Result

See Fingerprints

Previous Build

Next Build

Build #437 (Jul 27, 2011 12:40:18 PM)

Started 6 mo 28 days ago
Took 1 min 7 sec

Changes

1. version bump to 1.1-SNAPSHOT, added ignored UpdateLogbook selenium test (detail / hqweb)

Started by an SCM change

Test Result (no failures)

Module Builds

FreeSeasAhoy_Project0.94 sec

FreeSeasAhoy_Api5.4 sec

FreeSeasAhoy_General3.8 sec

fsahoy-main (didn't run)

FreeSeasAhoy_Manager1.3 sec

FreeSeasAhoy_MetaProject0.11 sec

FreeSeasAhoy_Server43 sec

FreeSeasAhoy_Test_Fixtures1.2 sec

FreeSeasAhoy_Utillities3.3 sec

Back to Project

Status

Changes

Console Output [raw]

View Build Information

Polling Log

Test Result

See Fingerprints

Previous Build

Next Build

Changes

Summary

1. version bump to 1.1-SNAPSHOT, added ignored UpdateLogbook selenium test

Changeset 765:38ce594f02c1 by Christoph Settgast :
version bump to 1.1-SNAPSHOT, added ignored UpdateLogbook selenium test

source/fsahoy-server/src/test/java/selenium/UpdateLogbook.java

source/fsahoy-api/pom.xml (diff)

source/fsahoy-general/pom.xml (diff)

source/fsahoy-manager/pom.xml (diff)

source/fsahoy-parent/pom.xml (diff)

source/fsahoy-server/pom.xml (diff)

source/fsahoy-test/pom.xml (diff)

source/fsahoy-utils/pom.xml (diff)

source/pom.xml (diff)

Back to Project

Status

Changes

Console Output [raw]

View Build Information

Polling Log

Test Result

See Fingerprints

Previous Build

Next Build

Test Result

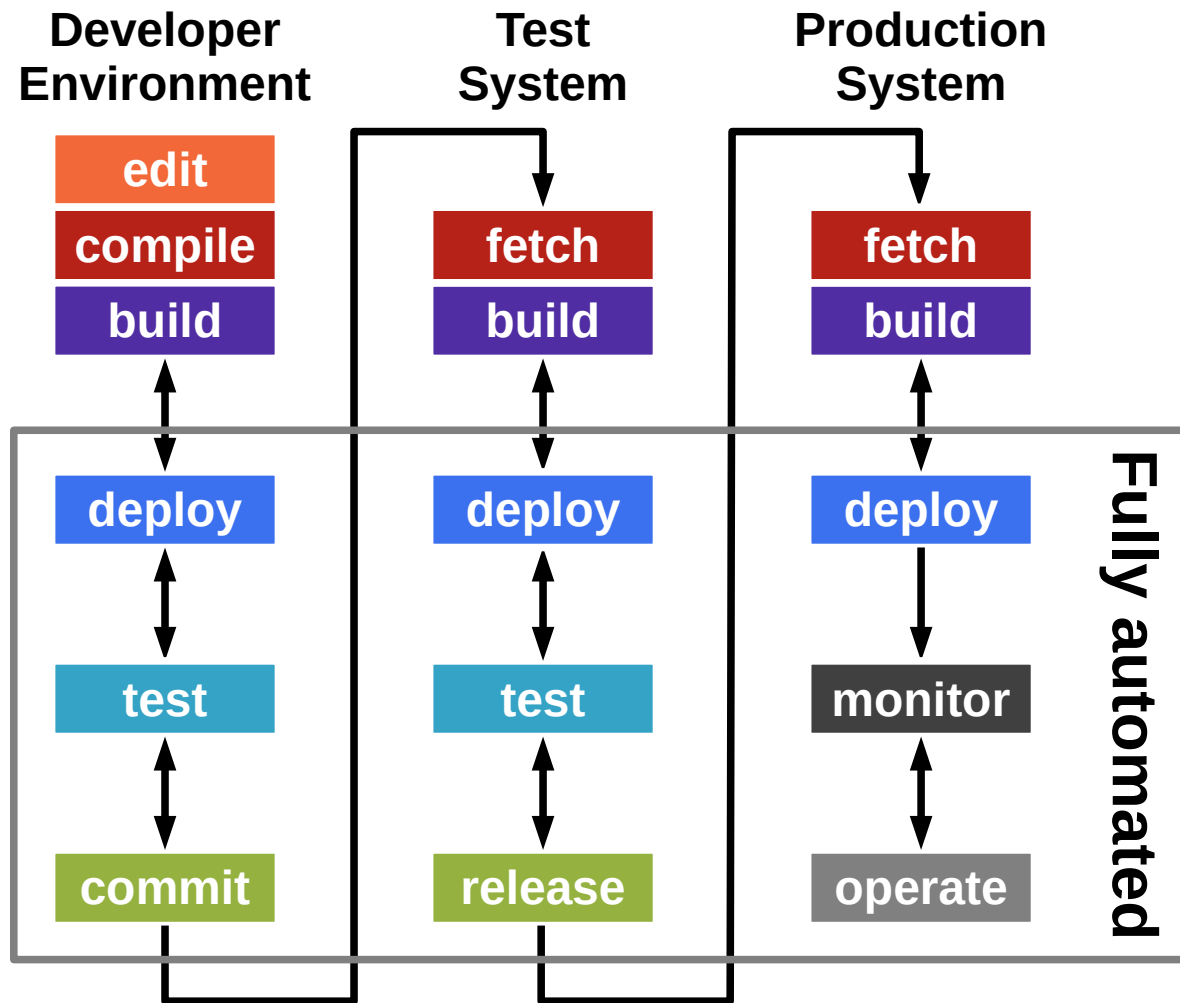
0 failures (±0) , 3 skipped (±0)

107 tests (±0)

Module	Fail	(diff)	Total	(diff)
de.fau.cs.fsahoy:fsahoy-api	0		2	
de.fau.cs.fsahoy:fsahoy-general	0		71	
de.fau.cs.fsahoy:fsahoy-server	0		20	
de.fau.cs.fsahoy:fsahoy-utils	0		14	

7. Continuous Delivery

Continuous Deployment Development Cycle



- Fully automated
 - Compile and build
 - Deployment
 - To test environment
 - To production
 - Test execution
- Partially automated
 - System monitoring
 - Automated rollback
- Human decisions
 - Commit decision
- No release decision

Continuous Delivery

- Continuous delivery is a delivery process
 - Upon trigger (commit to official repository)
 - the system is integrated, tested, and **deployed to production**
 - in a fully automated way (no human intervention)
 - A poorly functioning system may be rolled back
 - Requires monitoring and rollback facility of deployed system
 - System status is assessed using key figures
- The purpose of continuous delivery is to
 - put development results into production as fast as possible
 - improve quality by holding the team to high operational standards

- 1. Test automation**
- 2. Continuous integration**
- 3. Continuous deployment**

Continuous Delivery 2 / 2

- Test automation =
 - Tests and testing
- Continuous integration =
 - Test-driven development +
 - Automated building +
 - Test automation
- Continuous deployment =
 - Continuous integration +
 - Deploy to production +
 - Monitoring and rollback
- DevOps [1]
 - Continuous deployment +
 - Operations and culture

[1] Short for “development operations”

Summary

1. Test-first programming
2. Test-driven development
3. Pair programming
4. Pre-commit code review
5. Build management
6. Continuous integration
7. Continuous delivery

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
 - © 2010-2022 Dirk Riehle, some rights reserved