(XP)
Programming Practices

Prof. Dr. Dirk Riehle

Friedrich-Alexander University Erlangen-Nürnberg

AMOS E02

Agenda

1. General principles
2. Technical debt
3. Code refactoring
4. Test-first programming
5. Test-driven development

1. General Principles

KISS

(Keep It Simple, Silly)

YAGNI

(You Ain't Gonna Need It)

DRY

(Don't Repeat Yourself)

1. **Make it run**

2. **Make it right**

3. **Make it fast**

2. Technical Debt

Definition of Big Ball of Mud [FY97]

A Big Ball of Mud is a haphazardly structured, sprawling, sloppy, duct-tape-and-baling-wire, spaghetti-code jungle. These systems show unmistakable signs of unregulated growth, and repeated, expedient repair. Information is shared promiscuously among distant elements of the system, often to the point where nearly all the important information becomes global or duplicated. The overall structure of the system may never have been well defined. If it was, it may have eroded beyond recognition. Programmers with a shred of architectural sensibility shun these quagmires. Only those who are unconcerned about architecture, and, perhaps, are comfortable with the inertia of the day-to-day chore of patching the holes in these failing dikes, are content to work on such systems.

1. **Maintainability**
   (Easier to understand)

2. **Extensibility**
   (Easier to adapt and evolve)

3. **Predictability**
   (Improves planning ability)

Technical Debt

(Ward Cunningham)

[1]   See https://youtu.be/Jp5japiHAs4

Video Lessons

- Technical debt is a metaphor
  - Communicates well to manager
  - (Certainly in financial services)

- Taking on debt can speed up development
  - It may be justified to learn faster
  - But you have to pay up later

- If you don't pay back debt you'll slow down
  - Paying up means refactoring
  - Still, never write poor code deliberately

1. **Identify problem**
   (So-called "code smells")

2. **Identify need to act**
   (Correlate occurrences)

3. **Know how to act**
   (Refactor code)

Code Smell

- According to Fowler [F99]
  - "smells are certain structures in the code that indicate violation of fundamental design principles and negatively impact design quality"
  - also, "a code smell is a surface indication that usually corresponds to a deeper problem in the system"

- Code smells are not bugs

Example Code Smells

- Duplicated code
- Long method
- Large class
- ...

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3. Code Refactoring

Refactoring (Practice)

- Definition and purpose
  - Is a behavior-preserving transformation of existing source code
  - It is a change made to the internal structure of software to make it easier to understand and cheaper to modify without changing its observable behavior

- More on refactoring
  - Change the structure of code without changing behavior
  - Focus on non-functional features within range of specification
  - Are defined techniques that are typically language specific
  - Are ideally supported by IDEs, for example, the Eclipse JDT

- Defined by Opdyke [O92], popularized by Fowler [F99]

Example Refactorings

- Rename class
- Pull-up field
- Extract method
- …

- More at https://refactoring.com

```java
public class PhotoManager extends ObjectManager {
    protected Map<PhotoId, Photo> allPhotos = new HashMap<PhotoId, Photo>();

    public void addPhoto(Photo photo) {
        PhotoId id = photo.getId();
        assertIsNewPhoto(id);
        allPhotos.put(id, photo);
        ...
    }

    public Photo getPhotoFromId(PhotoId id) {
        Photo result = doGetPhotoFromId(id);
        if (result == null) {
            ...
            if (result != null) { allPhotos.put(id, result); }
        }
        return result;
    }

    public Set<Photo> findPhotosByOwner(String ownerName) {
        ...
        for (Iterator<Photo> i = r.iterator(); i.hasNext();) {
            Photo photo = i.next();
            allPhotos.put(photo.getId(), photo);
        }
        return r;
    }
    ...
```

```java
public class PhotoManager extends ObjectManager {

    public void addPhoto(Photo photo) {
        ...
        doAddPhoto(photo);
        ...
    }

    public Photo getPhotoFromId(PhotoId id) {
        ...
        doAddPhoto(photo);
        ...
    }

    public Set<Photo> findPhotosByOwner(String ownerName) {
        ...
        for (Iterator<Photo> i=r.iterator(); i.hasNext(); ) {
            doAddPhoto(i.next());
        }
        ...
    }

    protected void doAddPhoto(Photo myPhoto) {
        allPhotos.put(myPhoto.getId(), myPhoto);
    }

    ...
```

The "three strikes" rule

1st time: **Just do it**

2nd time: **Wince at duplication**

3rd time: **Refactor**
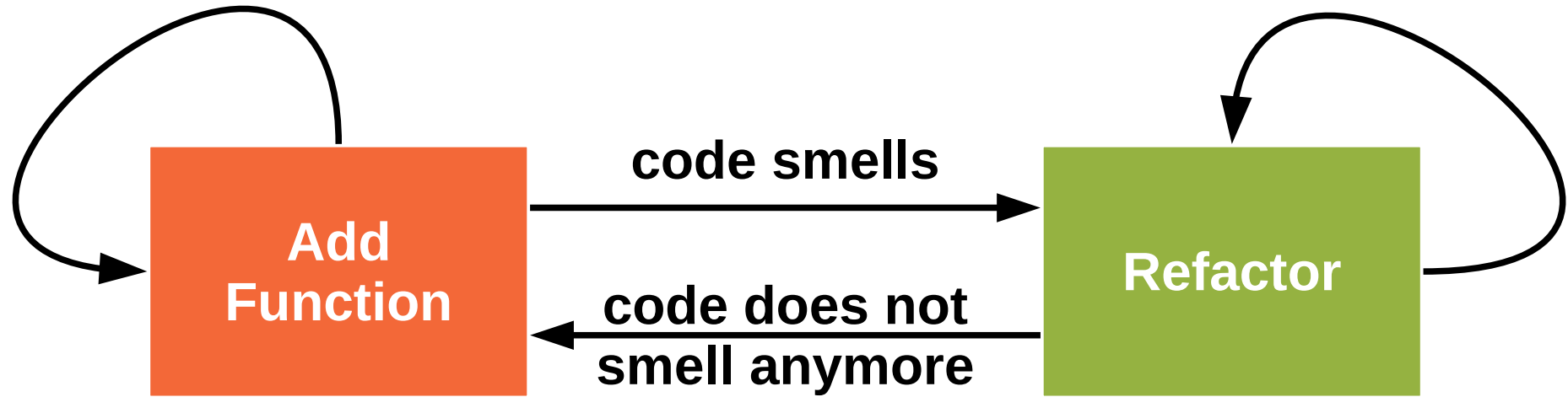
Code Smells and Refactorings

- Duplicated code

- Long method

- Large class

- ...

- Extract method

- Pull up field

- Form template method

- Decompose conditional

- Extract class

- Extract subclass

- Extract interface

- ...
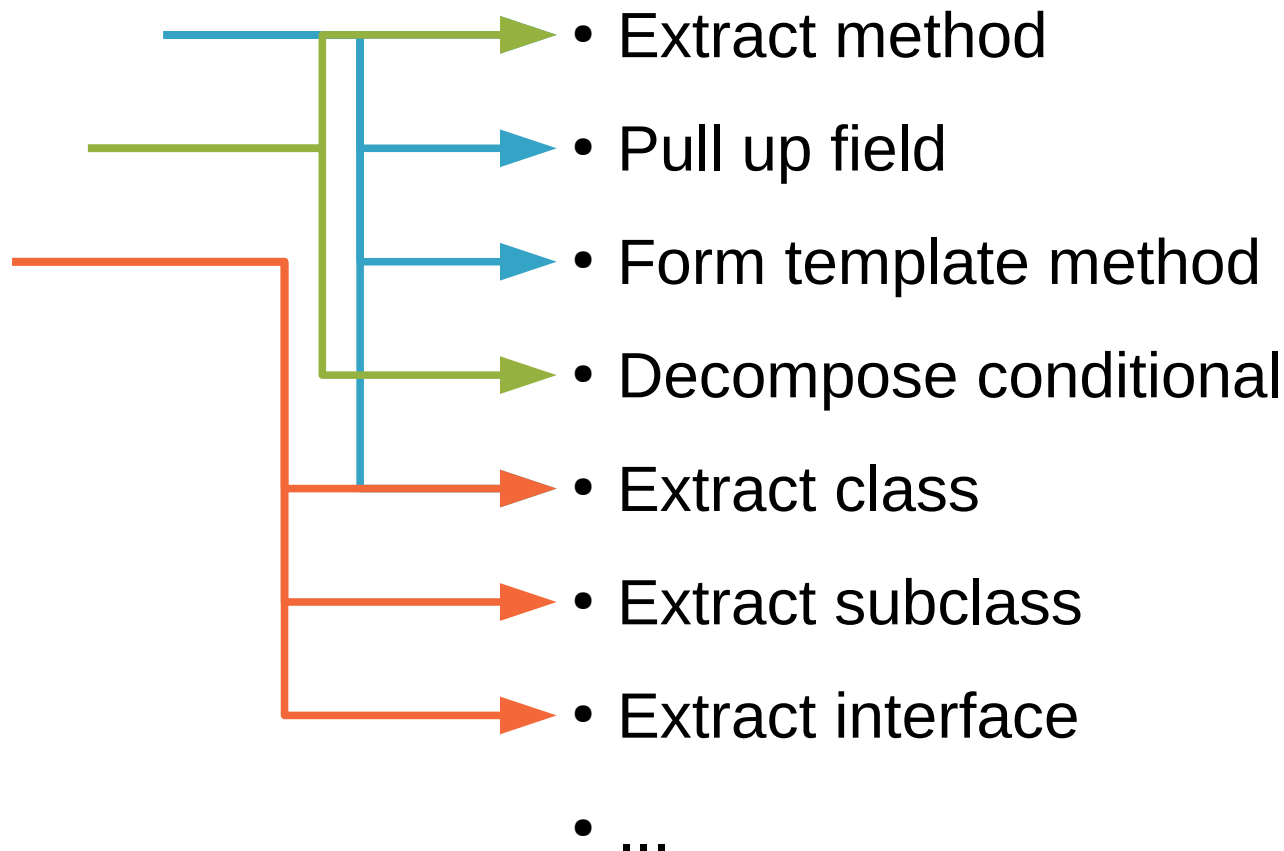
Example Refactoring Process

- The refactoring process can become complex
    - It may turn into a series of refactorings

- Example removal of switch statement
    - Extract method
    - Move method
    - Replace type code …
        - with subclass or
        - with state / strategy object

    - Replace conditional ...
        - with polymorphism

File   Edit   View   Navigate   Code   Analyze   Refactor   Build   Run   Tools   Git   Window   Help

wahlzeit › src › main › java › org › wahlzeit › model › Photo › setOwnerName   Debug Local App

Project

README.md   Photo.java

```
225   public String getOwnerName() {
226       return ownerName;
227   }
228
229   /**
230    *
231    * @methodtype set
232    */
233   public void setOwnerName(String newName) {
234       ownerName = newNa
235       incWriteCount();
236   }
237
238   /**
239    *
240    * @methodtype get
241    */
242   public String getSumm
243       return cfg.asPhot
244   }
245
246   /**
```

main
model
  AbstractModelConfig
  AccessRights
  Administrator
  Case
  CaseId
  Client
  EnglishModelConfig
  FlagReason
  Gender
  GermanModelConfig
  Guest
  LanguageConfigs
  ModelConfig
  Moderator
  Photo
  PhotoCase
  PhotoCaseManager
  PhotoFactory
  PhotoFilter
  PhotoId

Context menu:
Show Context Actions   Alt+Enter
Paste   Ctrl+V
Copy / Paste Special
Column Selection Mode   Alt+Shift+Insert
Find Usages   Alt+Shift+7
Refactor
Folding
Analyze
Go To
Generate...   Alt+Insert
Open In
Local History
Git
Compare with Clipboard
Create Gist...

Refactor submenu:
Rename...   Shift+F6
Change Signature...   Ctrl+F6
Make Static...
Move Instance Method...   F6
Copy Class...   F5
Safe Delete...   Alt+Delete
Introduce Parameter Object...
Type Parameter...
Extract Delegate...
Extract Interface...
Extract Superclass...
Inline Method...   Ctrl+Alt+N
Find and Replace Code Duplicates...
Pull Members Up...
Push Members Down...
Migrate to AndroidX...
Add Right-to-Left (RTL) Support...

Build: Sync

✓ wahlzeit: finished At 18.03.21, 13:20   1 min, 32 sec, 345 ms   Download https://se...   75 ms (102.67 MB)
Starting Gradle Dae...
Gradle Daemon started in 654 ms

BUILD SUCCESSFUL in 1m 3s

Git   TODO   Problems   Terminal   Build

Rename the selected symbol and correct all references   233:26   LF   UTF-8   Tab*   main

Quiz on Refactoring

- Your code smells. All signs for refactoring are given. Under which circumstances should you not start a refactoring?

4. 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**
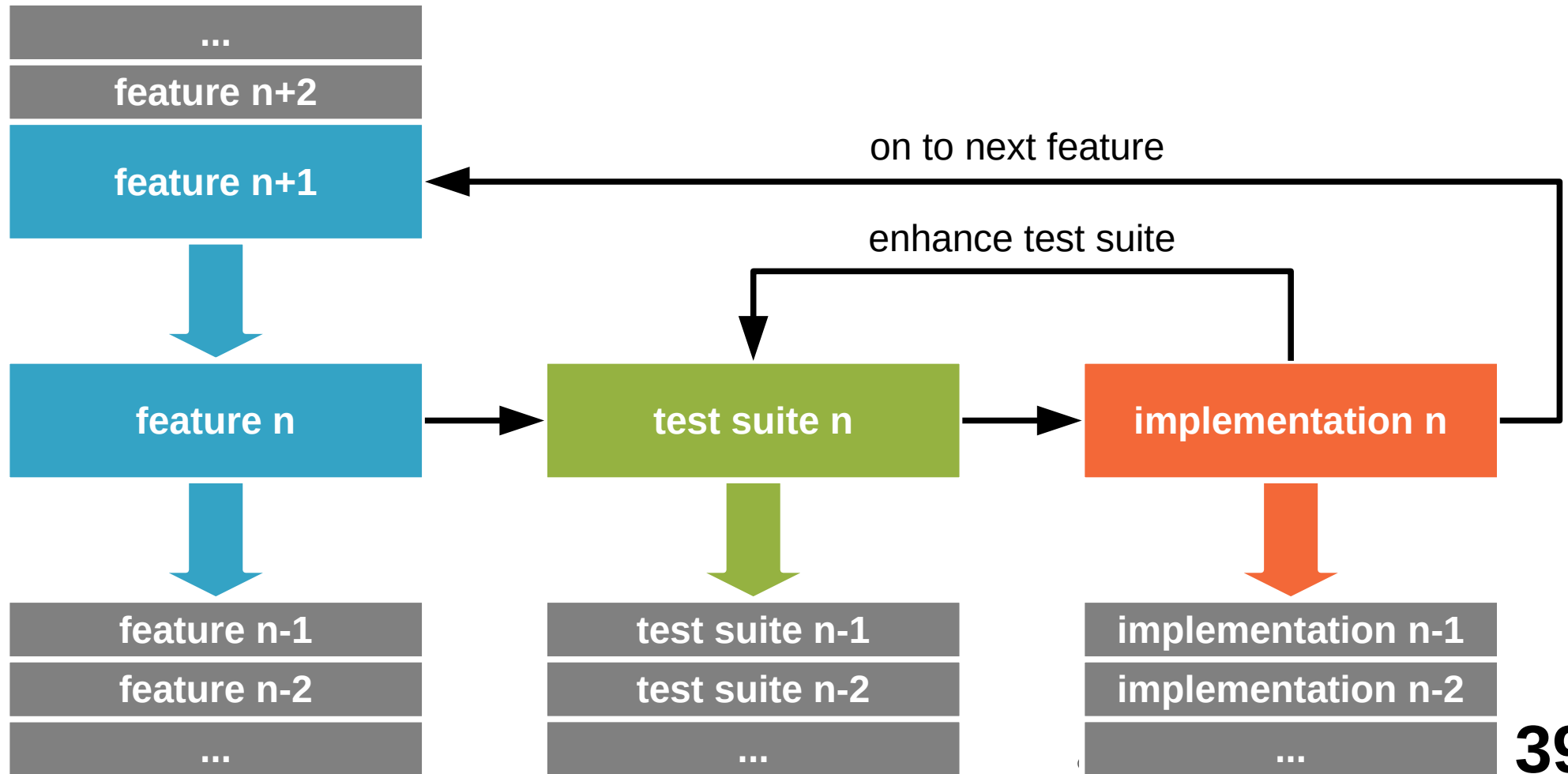
5. Test-Driven Development

- 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

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
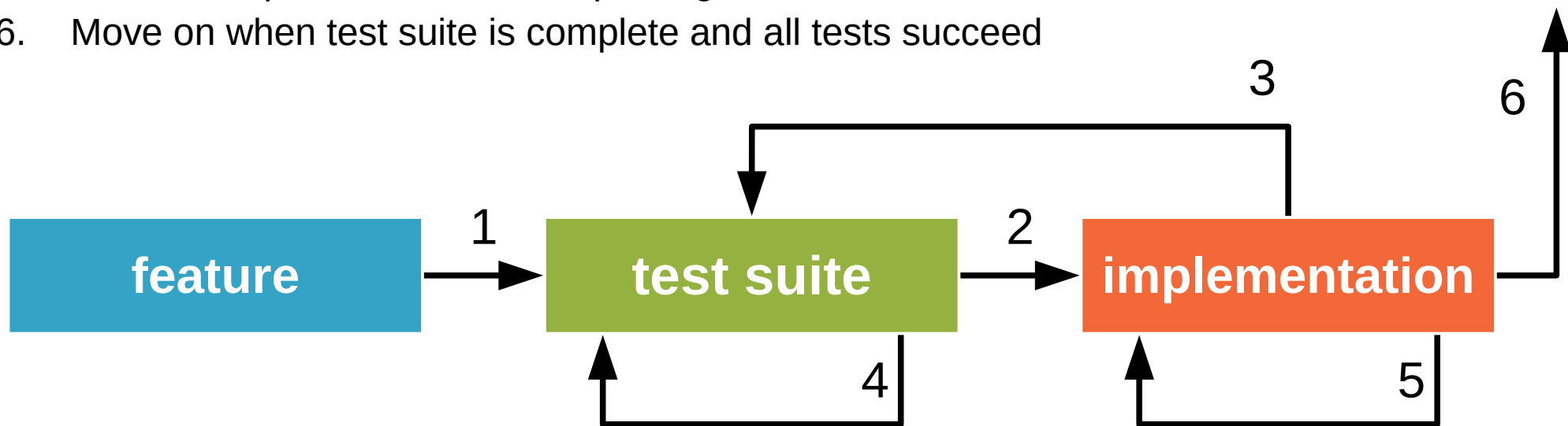
Review / Summary of Session

- Agile principles of programming
  - KISS, YAGNI, DRY
  - Make it run, right, fast

- Technical debt and refactoring
  - Principles, two hats
  - Example refactorings and tools

- Tests and test-driven development
  - Test-first programming
  - The simplest of all processes

Thank you! Questions?

dirk.riehle@fau.de – **http://osr.cs.fau.de**

dirk@riehle.org – http://dirkriehle.com – @dirkriehle

DR

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- Contributions
    - None yet