The Software Engineering Education Tripod: Students, Teachers, and Industry

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Research and Teaching Group of Speaker

- Professor of Software Engineering at FAU
  - Officially “Professor of Open Source Software” since 2009
  - At Friedrich-Alexander University Erlangen-Nürnberg
- Previously held research positions at ...
  - SAP Labs (Silicon Valley) leading the open source research group
  - UBS (Swiss Bank, Zurich) leading the software engineering group
- Previously worked in product development at ...
  - Skyva Inc. (supply chain software startup, Boston) as software architect
  - Bayave GmbH (on-demand business software, Berlin) as CTO

Teaching Goals / Model of Group [1]

Job Profiles

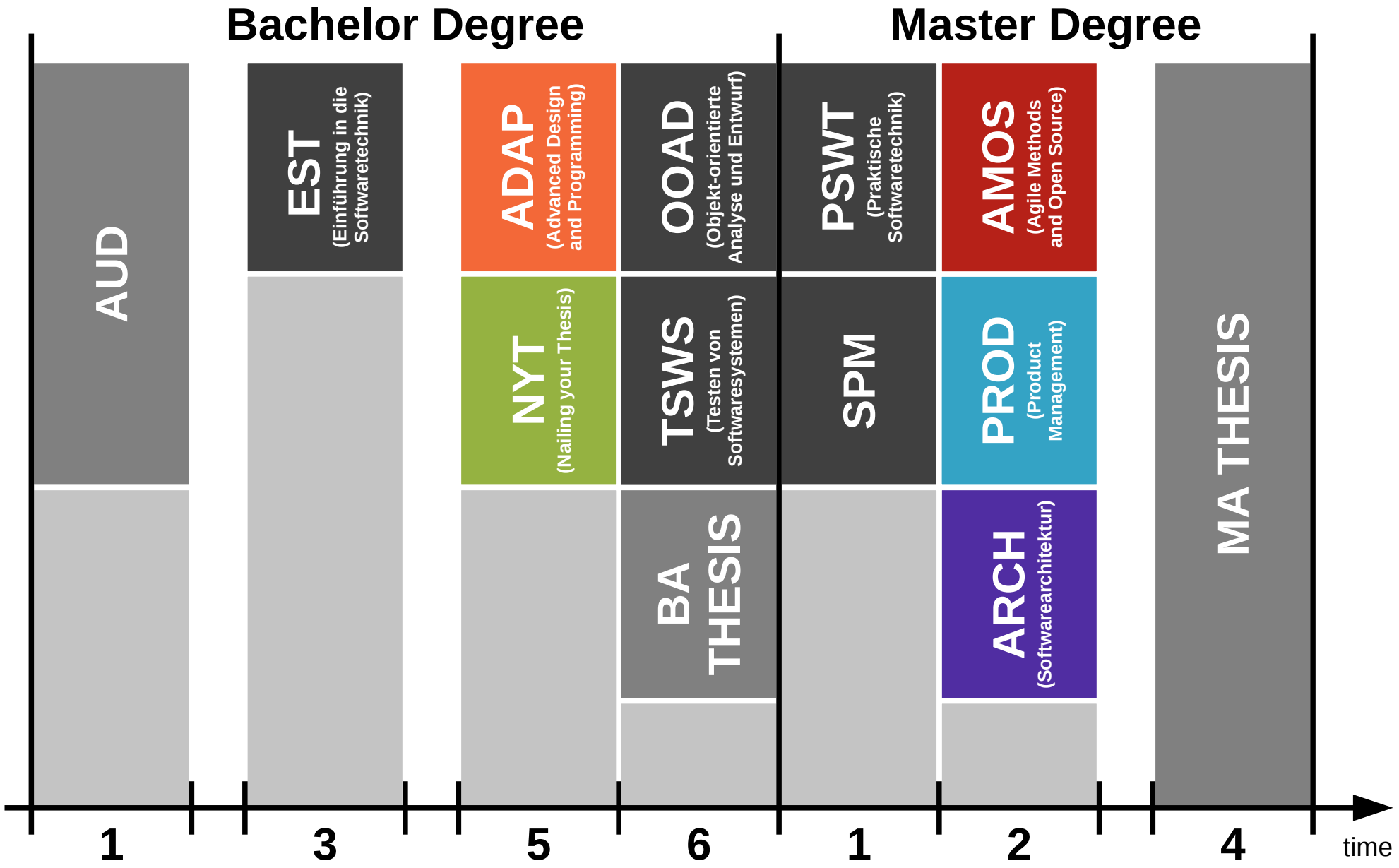
- Software developer
- Engineering manager
- Product manager
- Researcher

Employers

- Established companies
- Product startups
- Research labs

[1] Please see http://wp.me/pDU66-1aQ for more details (in German)

Software Engineering Curriculum

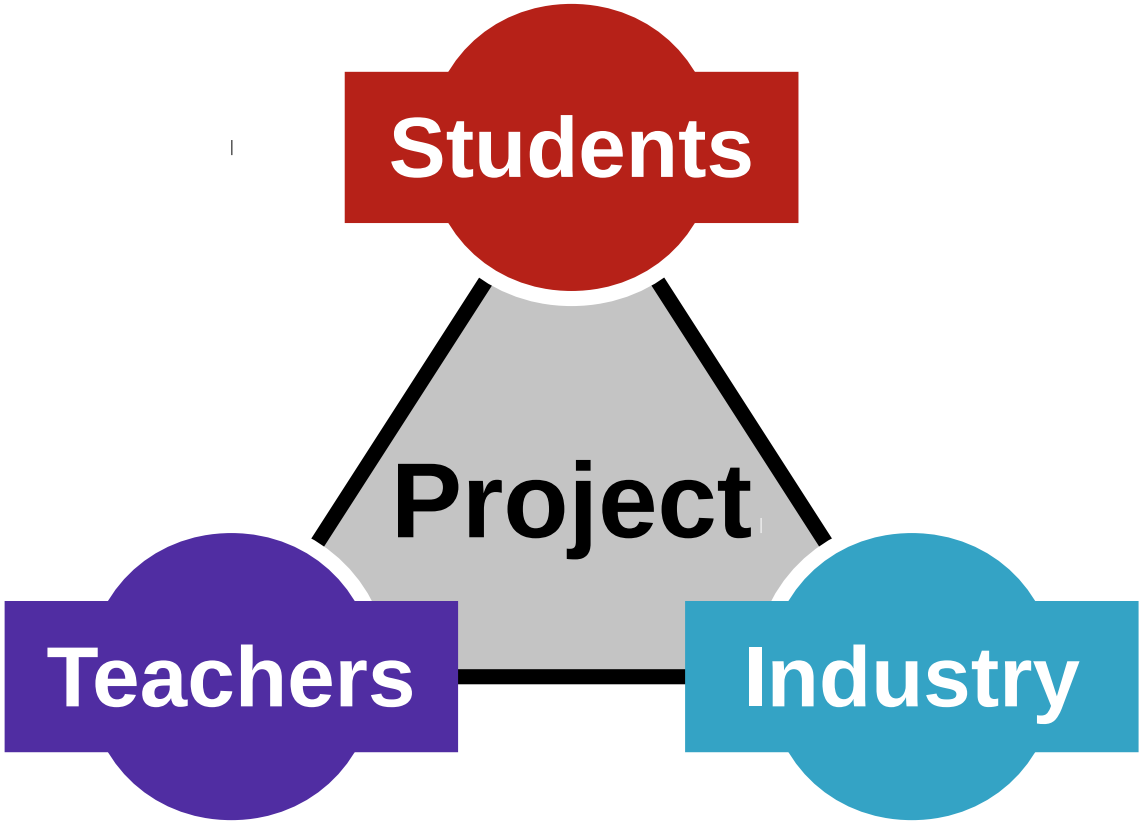


The Case for Project-Based Learning

- Approachability of subject matter
- Effectiveness of knowledge acquisition
- Effectiveness of know-how acquisition
- Student motivation and engagement

→ Use semester-long project as substrate

Stakeholders



Stakeholder Motivation

- Students
  - Achieve learning goals
  - Perform meaningful work
- Industry
  - Meet recruiting goals
  - Benefit from student work
- Teachers / University [1]
  - Fulfill educational mission
  - Fulfill economic mission

[1] Please note: These are not the same, sometimes there are conflicts of interest, but we'll ignore those for simplicity's sake.

Current Project-based Courses

Goal: learn agile methods

Project: software development

Goal: learn product management

Project: product business case

Goal: learn scientific work

Project: research project

The AMOS Project

- Learning objectives
  - Understand logic of agile methods (Scrum)
  - Acquire skills to perform agile projects, use tools
- Teaching approach
  - Project-based learning using semester-long project
  - Project acquired and performed in cooperation with industry partner
- Grading approach
  - Classroom participation and weekly work
  - Final demo and effort moderates grade

Project Participant Roles

- Students / teams
  - Perform product management and software development work
    - Product manager (product owner) for 5 ECTS
    - Software developer (“team member”) for 10 ECTS
    - Other dynamic roles (Scrum master, release manager, ...)
- Industry partner
  - Provides high-level requirements and incremental feedback
- Teachers
  - Performs process quality assurance, student guidance

Course Content 1 / 2

- Process best practices (Scrum and related)
  - Release, sprint, day planning practices, …
  - Sprint retrospectives (process improvement)
- Technical best practices (XP and related)
  - Refactoring, test-driven development, continuous integration, ...
  - Code review, pair programming, ...

Course Content 2 / 2

- Components, frameworks, libraries
  - Java, JUnit, Selenium, Eclipse IDE, ...
  - Tomcat, Hibernate, PostgreSQL, Servlets, …
  - Android, Linux, Windows, ...
- Software engineering tools
  - Git (svn), maven, bug tracker, Google Docs
  - Not yet dedicated agile methods tools

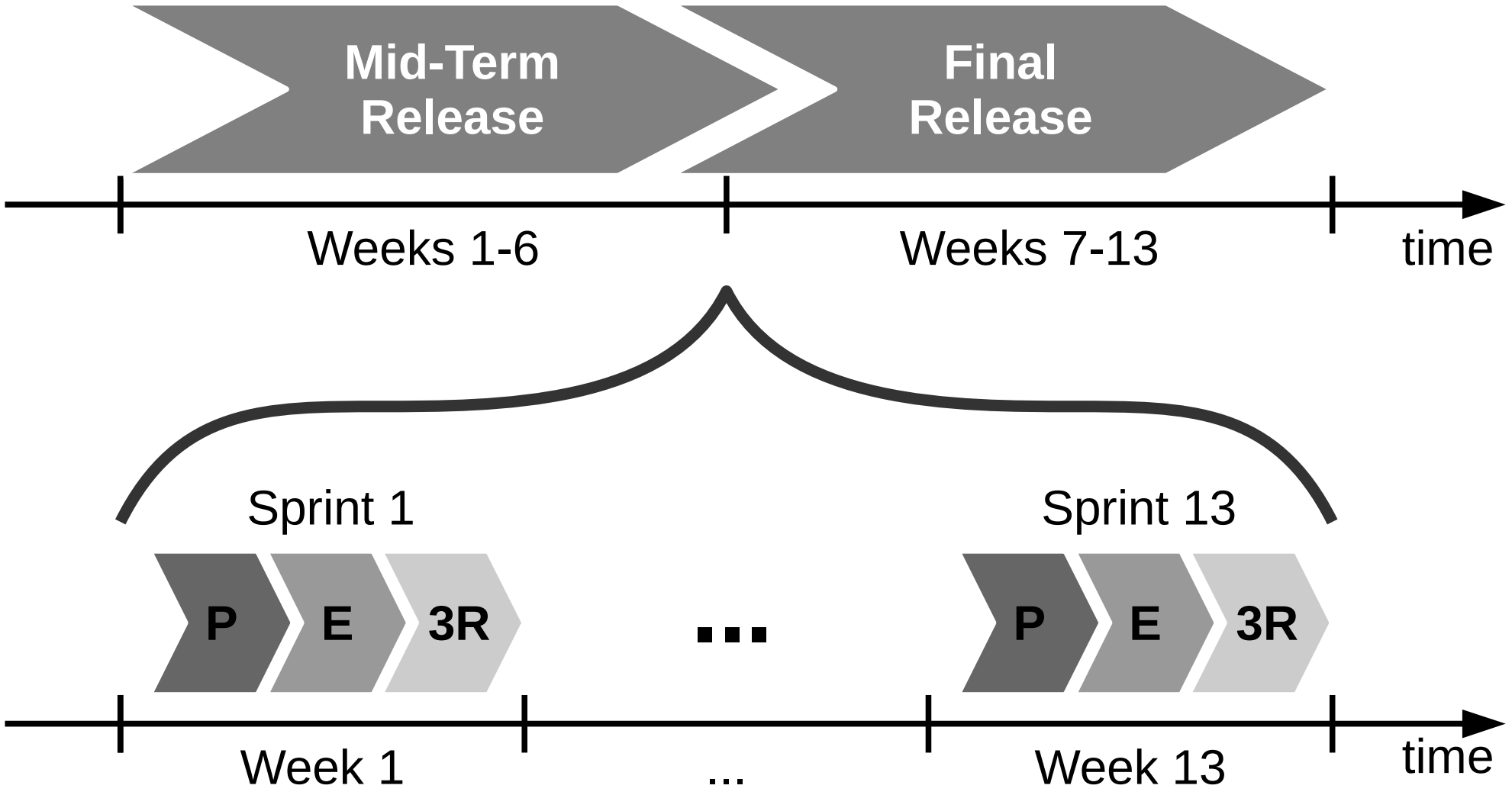
Course Staffing

- Functional roles
  - Lectures and exercises
  - Tech support and operations
  - Product owner guidance
  - Software developer guidance
- Alternatives too expensive
  - Team coaches
- Future: crowdgrading
  - To improve feedback quality

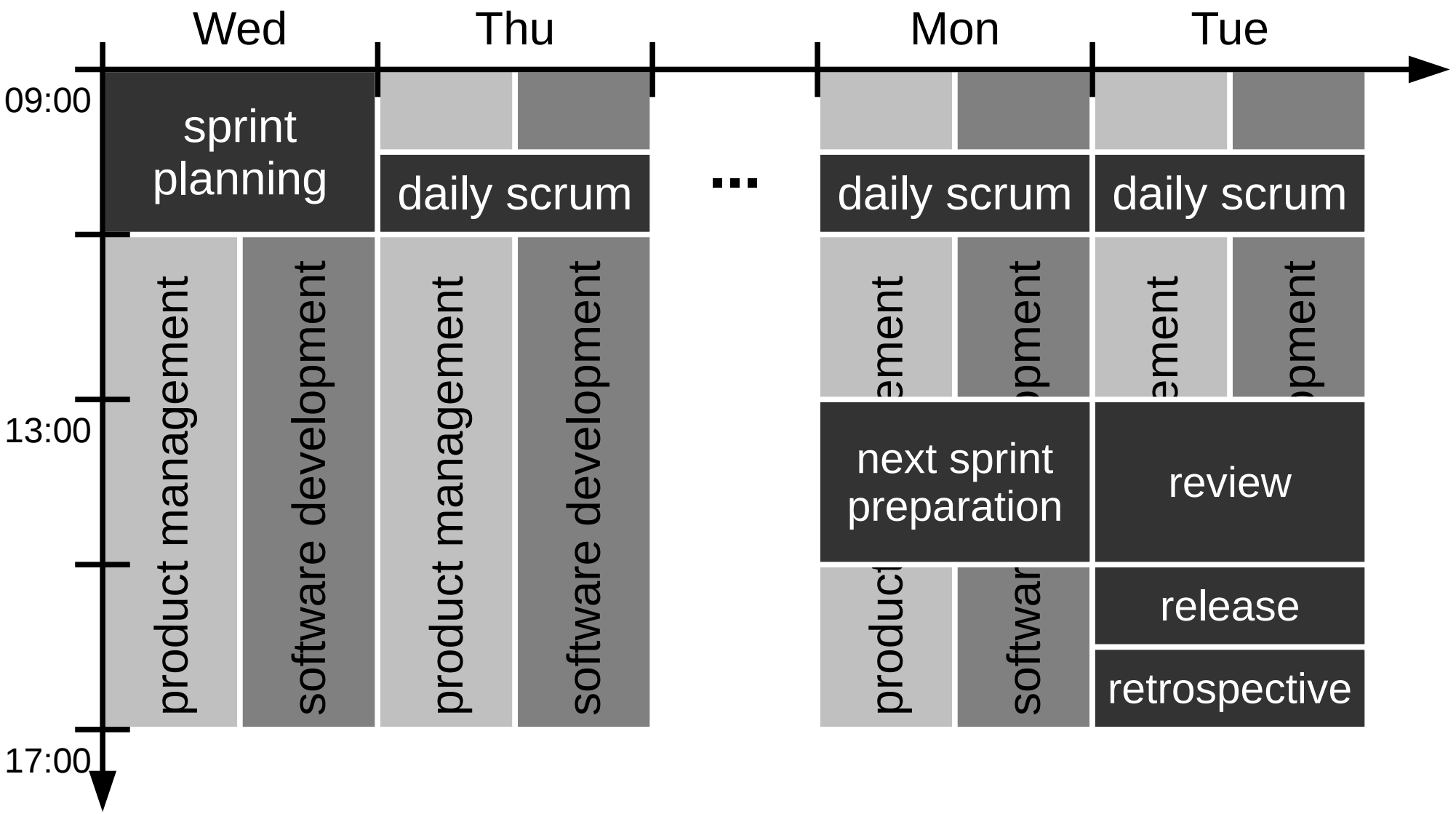
Student Demographics

- Degree programs
  - 50% computer science students
  - 50% information systems students
- Degree level
  - 80% Master students
  - 20% Bachelor students

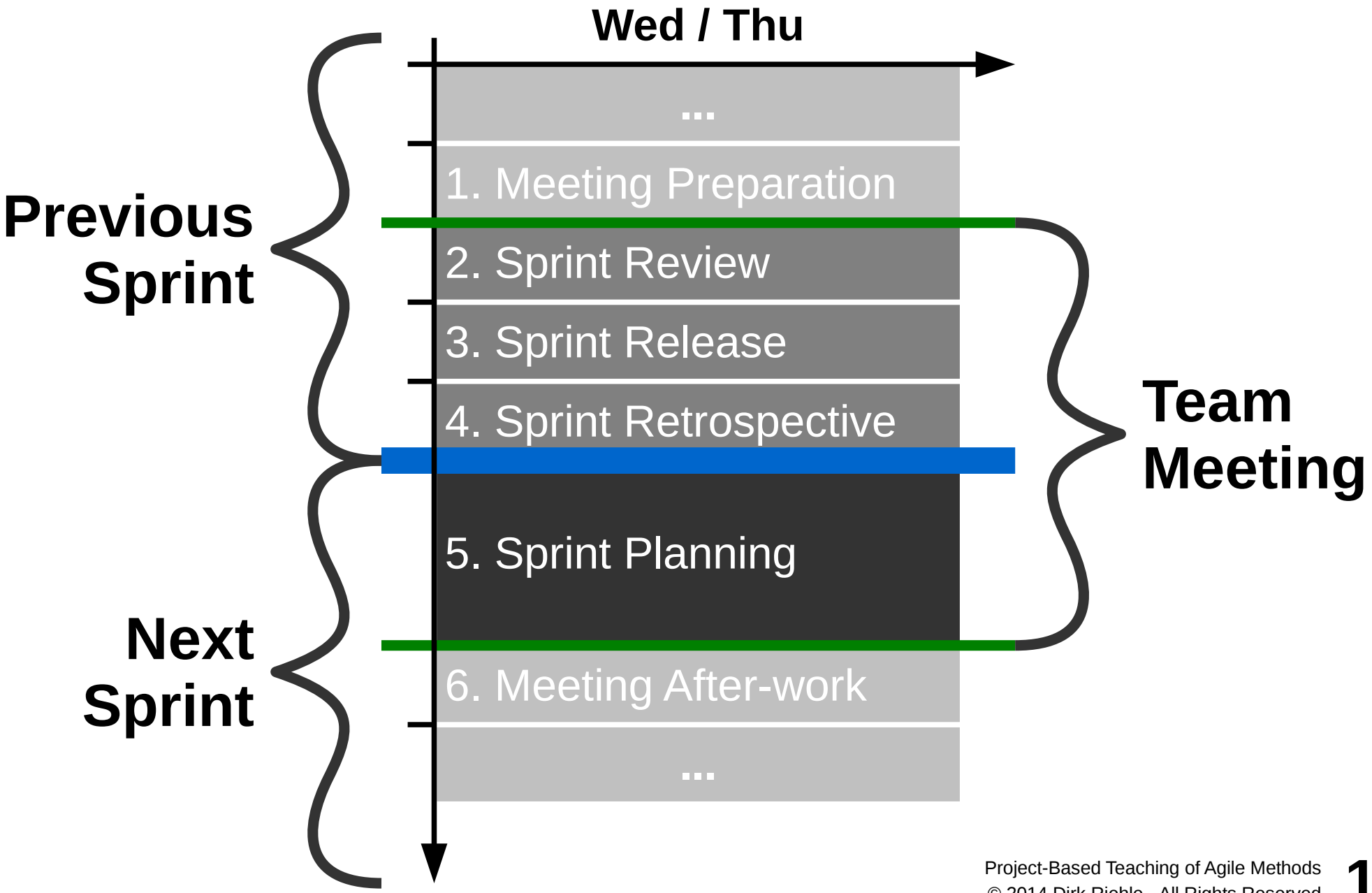
Time-Line: Semester



Time-Line: Iteration (Week)



Time-Line: Meeting Day



Industry Motivation

1. Recruiting
2. Outsourcing
3. Innovation
4. Ecosystem

History of Industry Partners

2012 (SS): Industry trial

2013 (SS): Industry partners

2014 (SS): Academic trial, industry partners

2015 (SS): Industry and academic partners...

Project Acquisition

1. Marketing
2. Project pricing
3. Intellectual property

Teacher / University Motivation

1. Teaching duties
2. Sponsorship
3. Student startups
4. Follow-on projects

Course Results

- Students
  - Teaching evaluation above average; the occasional outlier
  - Useful real work with industry partner is incredibly motivating
- Industry partners
  - Most want to return, some have done so already
  - Project facilitated student jobs, useful software
- Teachers / University
  - Projects finance a fair bit of research support
  - Four startups in different stages of gestation [1]

[1] See http://startupinformatik.de (in German)

Root Cause of Course Challenges

The combination of

1. **Transient teams**
2. **Self-organization**

Key Things That (Can) Go Wrong

1. Uncommitted teams
2. Vastly differing abilities
3. Clash of personalities
4. Unspoken expectations

Preparation / Counter Measures

1. Team constitution
2. Team-building workshop
3. Team contracts

Open Source Research Surveys

2014 AMOS Course Entry Survey

Student entry survey for our project-based courses (AMOS, ARCH, PROD, NYT, TSWS).

0% 100%

Students

***Please tell us whether you are a Bachelor or a Master student:**

Choose one of the following answers

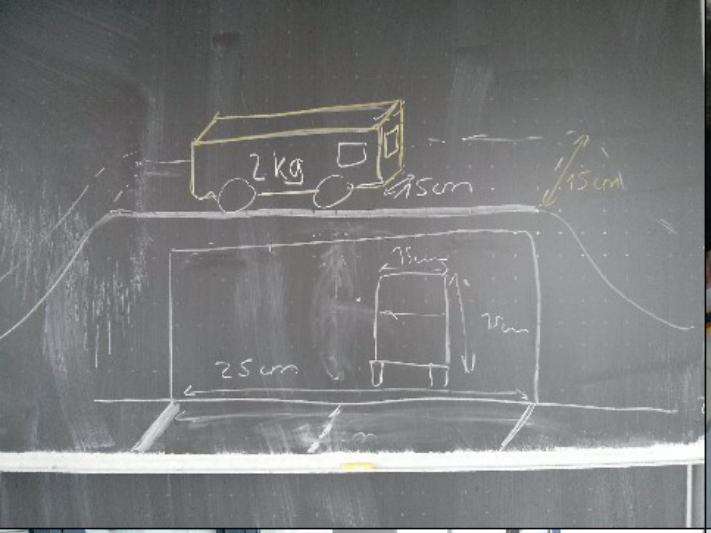
- ○ Bachelor/ette Student (or Vordiplom)
- ◉ Master Student (or Haupdiplom)

***Please tell us about your work experience. If you had no work experience, please just leave the checkmark at none.**

	None	Part-time, less than 6 months	Part-time, less than 2 years	Part-time, more than 2 years	Full-time, less than 6 months	Full-time, less than 2 years	Full-time, more than 2 years
I have/had a job as a software developer:	○	○	○	○	○	◉	○
I have/had a job as a product manager:	◉	○	○	○	○	○	○
I have/had other work experience in industry:	◉	○	○	○	○	○	○

***Please tell us about your technical background and experience:**

	Not at all	I'm a Beginner	I'm Intermediate	I'm an Expert
I have worked with git and / or GitHub:	○	○	◉	○
I have worked with maven:	◉	○	○	○
I have worked with the Java platform:	○	○	○	◉
I have worked with C# technologies:	◉	○	○	○
I have worked with Java and Android:	○	◉	○	○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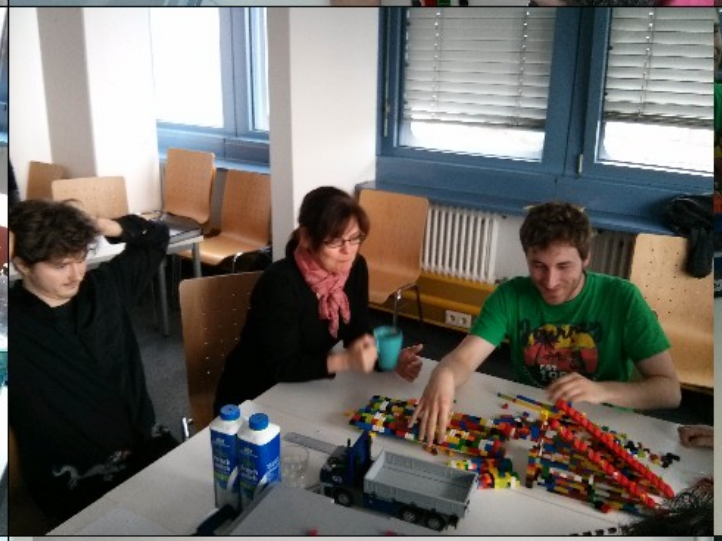
15 cm
15 cm
25 cm


MARKUS
DEUTSCHLAND


FM CARGO



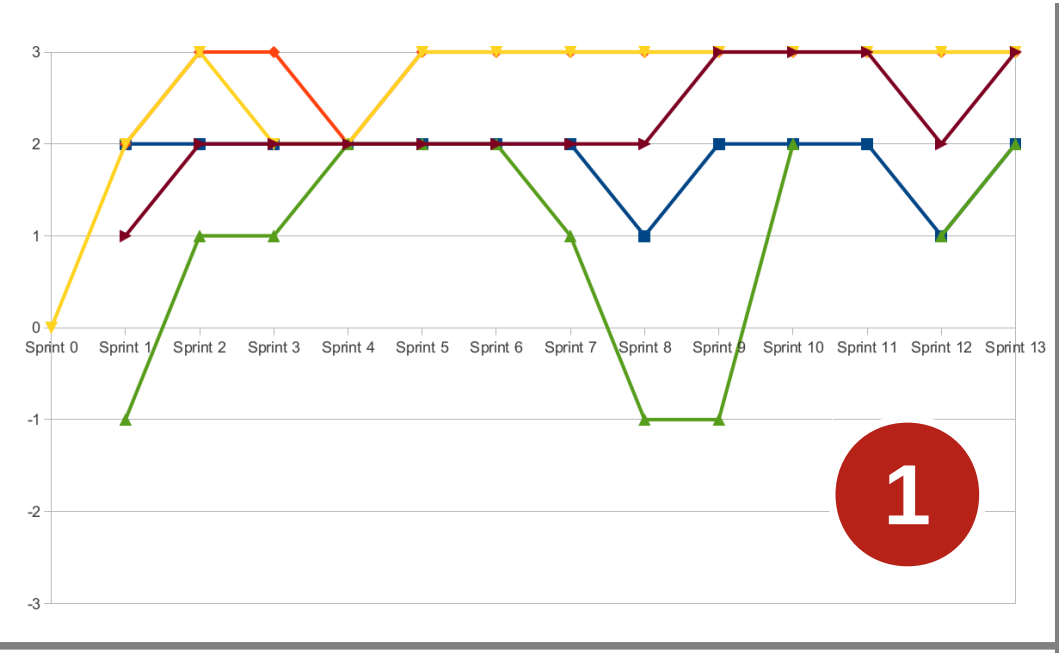

FM CARGO

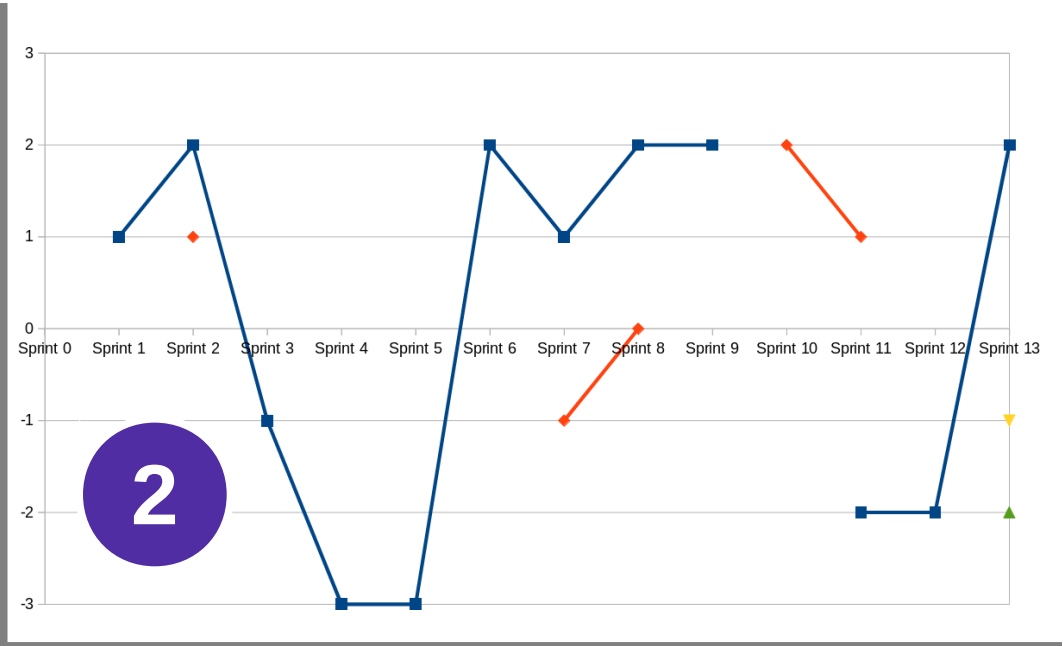

2 kg

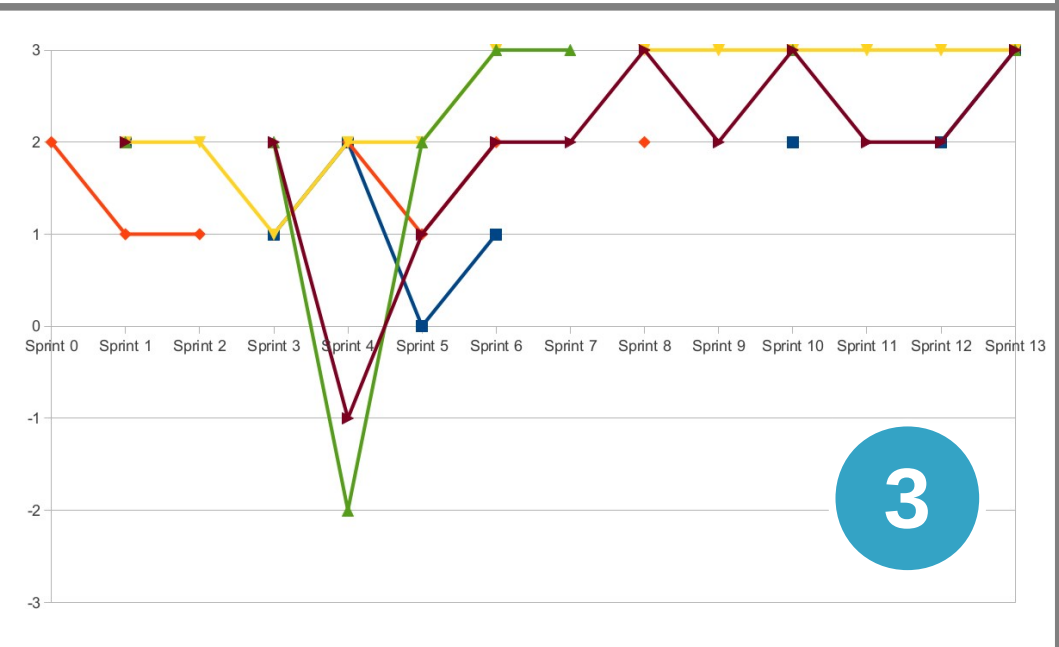
Team Contract

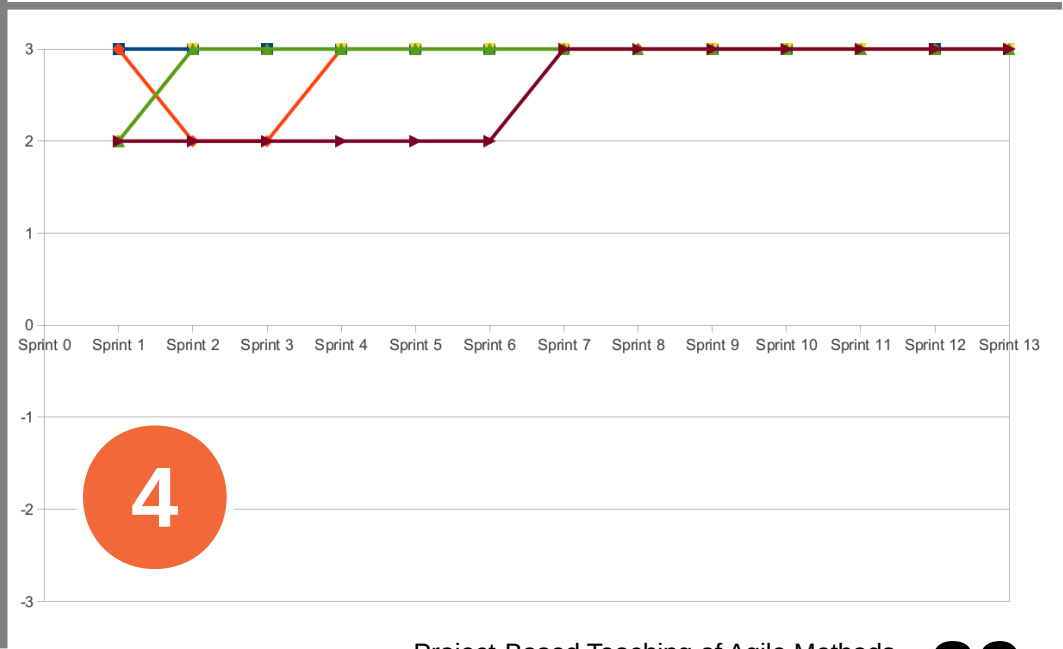
- A Team Contract makes explicit
  - Expectations towards project and team
  - Desired and undesired behavior
  - Rewards and sanctions
- Student teams create one
  - When the project starts
  - And commit in writing
- Teachers use it during mediation

Steering Feedback









Conclusions (for Now)

- Course is evolving at a rapid pace
  - Addition of academic partners (to industry partners)
    - To cope with resource problems
    - To foster Germany-compatible startups
  - Introduction of consulting company metaphor
    - To address team problems more effectively
    - To broaden learning scope, experiences
  - ...

Thanks! Questions?

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