Teaching Software Engineering As Programming Over Time

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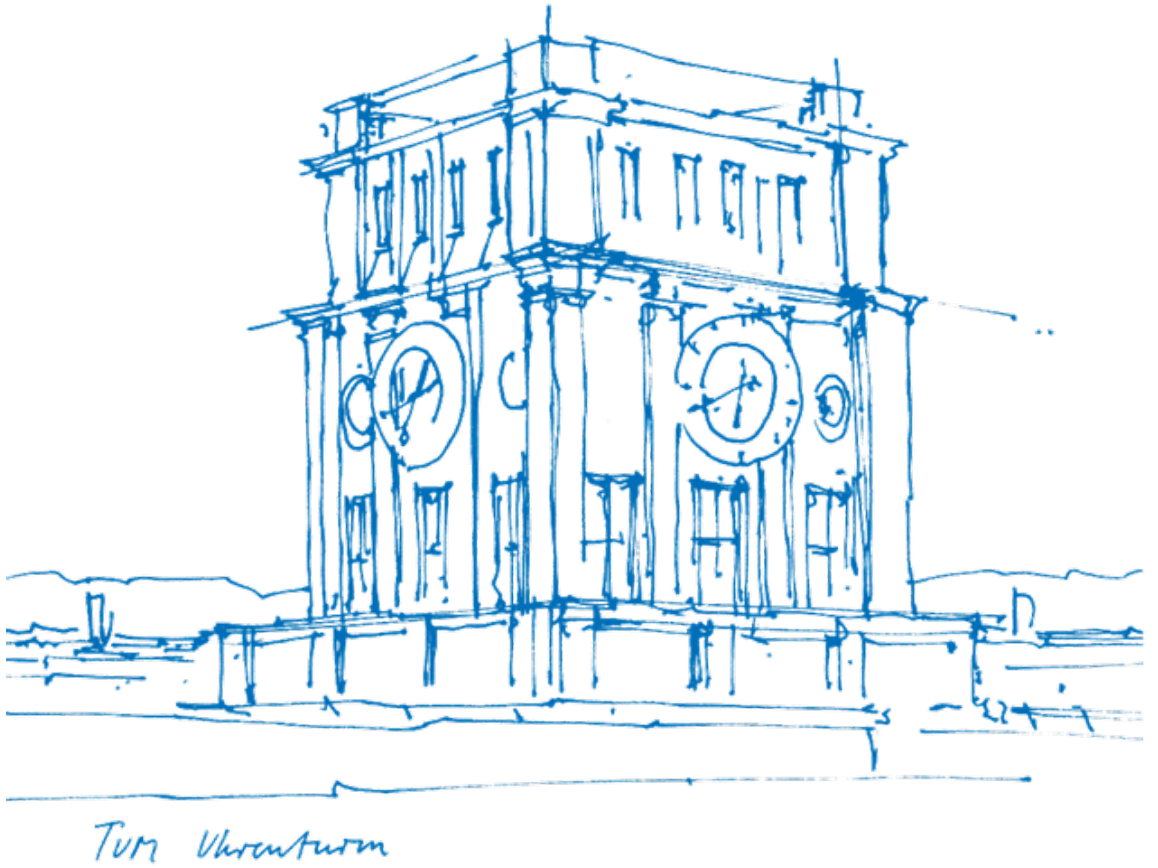


Programming at University

- Individual assignments
- Focus on task completion
- Short project lifetime
- Single contributor or small teams

Software Engineering in Industry

- Lifetime over years
- Software needs to be maintained over time
- Things change over time
- Larger number of contributors
- Contributors change over time

Our Goal

- Awareness of time and change
- Collaborative development
- First introduction to common techniques used in software engineering

Software Engineering vs. Programming

"Software engineering" differs from "programming" in dimensionality

> Titus Winters, Hyrum Wright, and Tom Manshreck. "Software Engineering at Google: Lessons Learned from Programming over Time." (2020)

- **Programming** is about "sitting down" and producing code
- **Software Engineering** extends that to include the maintenance of that code for its useful life span (time and scale)

Course Structure

Concept

- Lectures introduce new concepts
- Practical homework assignments to apply the concepts

All homeworks contribute to a single codebase managed by the students for the entire course

Students

- Undergraduate students
- Basic programming knowledge
- In our case: C-Course

Starting Point

- GitLab repository with initial codebase
- Codebase without build system, tests, or documentation

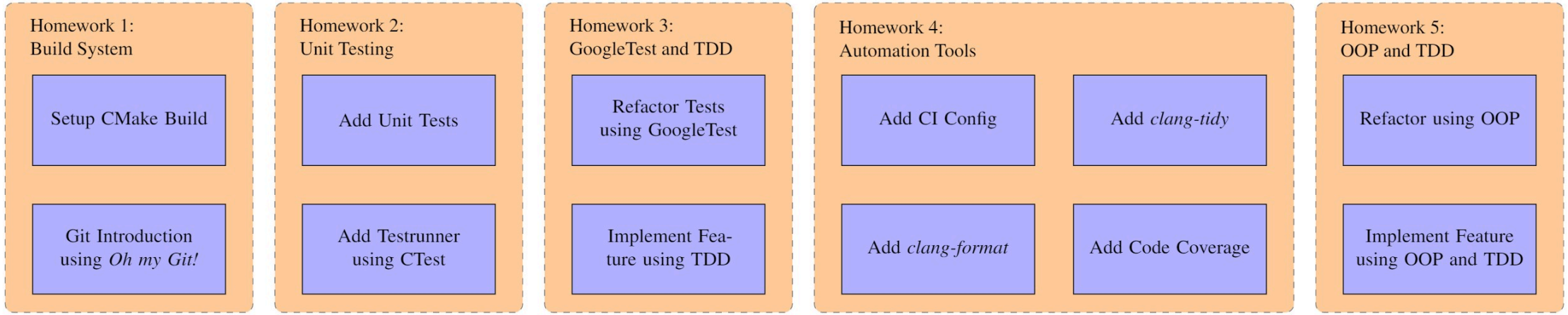
Lectures

1. Build systems, collaboration, and version control
2. Unit testing, refactoring, and debugging
3. Test frameworks and test driven development (TDD)
4. Automation tools (CI, formatters, static code analysis) and refactoring
5. Basics of object oriented programming and real world examples

Lecture Structure

- Theory, concepts, and reasons
- Live demonstrations how to use the concepts

Homework Assignments



Evaluation

- Evaluation of the homework assignments per team
- Final written exam evaluated per student

Final Exam

- General questions
- Code review
- Implementation tasks

Course Management

Slides and Documents

- Markup-based files
  - Markdown for slides (Marp)
  - AsciiDoc for documents
- Usable with version control
- Seamless integration with source code files

Teaching Tools

- One codebase as single source of truth
- Automatically generate student materials from codebase
- Remove solutions from based on predefined delimiters
- Create N repositories with predefined settings and initial code
- Create or comment to project issues using slide content

Homework Evaluation

- Evaluation framework to automatically evaluate KPIs
- Manual review for code smells

Lessons Learned

Observations and Improvements

- Expressive naming: Code and commit messages
  - Offer quizzes and enforce code reviews
- TDD: Uncertainty what to test
  - Increase number of examples and demonstrations
- Continuous integration of code
  - Students often submit entire homework as single PR

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Code

https://github.com/hofbi/teaching-tools

https://github.com/hofbi/tum-marp-template

Contact

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