Lecture 01.2: Introduction to Software Engineering

Dietmar Pfahl
email: dietmar.pfahl@ut.ee

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Schedule of Lectures

Week 01: Introduction to SE
Week 02: Requirements Engineering I
Week 03: Requirements Engineering II
Week 04: Analysis
Week 05: Development Infrastructure
Week 06: Continuous Development and Integration
Week 07: Project Estimation / Architecture and Design I
Week 08: Architecture and Design II
Week 09: Verification and Validation I
Week 10: Verification and Validation II
Week 11: Refactoring (and TDD)
Week 12: Agile/Lean Methods
Week 13: Industry Guest Lecture
Week 14: Course wrap-up, review and exam preparation
Week 15: Reserve time slot (no lecture scheduled as of today)
Software Engineering

What?
Why?
Software Development – Three Ps

- Software Development

Project or Iteration
Software Development – Three Ps

- Software Development

Products

People

Processes

Project or Iteration
Software Development – Three Ps

- Software Development
- Project or Iteration
- Products
- People
- Processes
Products in Software Development
Products in Software Development

```java
class ISort {
    public static void insertionSort(int[] a, String direction) {
        int in, out;
        for(out=1; out<a.length; out++) {
            int temp = a[out];
            in = out;
            while((in>0 && a[in-1] >= temp && direction.equalsIgnoreCase("A")) || (in>0 && a[in-1] <= temp && direction.equalsIgnoreCase("D"))) {
                a[in] = a[in-1];
                --in;
            }
            a[in] = temp;
        }
    }
}
```
Products in Software Development

**Code:**
- Production code:
  - Source code
  - Object code
- Non-production code:
  - Test code

**Non-Code:**
- Requirements
- Specifications
- Architecture/Design docs
- Issue reports
- User manuals
- Plans of all kinds
- ...

**Properties of Software:**
- Functionality
- Reliability
- Usability
- Efficiency
- Maintainability
- Portability

**Types of Software:**
- Embedded/real-time
- Information System
- Web application
- Mobile application
- Systems of systems
- ...

**Models**
Software in a Car

State-of-practice:
- 40-100 ECUs
- 5-10 Mio Lines of Code
- > 100 MB Software
- > 3 Bus Systems

ECU = Electronic Control Unit

Autonomous driving
Secure cloud communication

Source:
Properties of Software

The software should deliver the required functionality and performance to the user and should be maintainable, dependable and acceptable.

Maintainability
Software must evolve to meet changing needs;

Dependability (Reliability)
Software must be trustworthy;

Efficiency
Software should not make wasteful use of system resources;

Usability
Software must be accepted by the users for which it was designed. This means it must be understandable, usable and compatible with other systems.
SW Product Modeling

UML = Unified Modeling Language

Online information: http://www.uml.org
Software Development – Three Ps

- Software Development
- Products
- Processes
- People

Project or Iteration
People in Software Development

Roles:
- Project Manager
- Product Manager
- Architect/Analyst
- Programmer
- Tester
- ...

Teams:
- Team building
- Geographically distributed (international/global)
- Mechanisms for collaboration/cooperation
- Motivation, Personality, Values, Culture

Skills:
- Must match roles

Training:
- Must fill skill-gaps

Education:
- Curricula (ACM/IEEE)

User models
Software Development – Three Ps

• Software Development
  
  - Project or Iteration
  - Products
  - People
  - Processes
Software Development Process

Coding → Deploying
Software Development Process

1. Find Requirements
2. Analysis / Designing
3. Coding
4. Testing
5. Deploying
Software Development Process

(Royce, 1970)
Processes in SW Development

Process (Model) Elements:
- Activity
- Input/Output Product(s)
- Roles
- Methods/Techniques/Tools

Process Taxonomy:
- Non-engineering processes
  - Business processes
  - Social processes
- Engineering processes
  - Product-engineering proc.
    - Technical prod.-eng. proc.
    - Managerial prod.-eng. proc.
  - Process-engineering proc.

Process Modeling:
- Descriptive PMs
- Prescriptive PMs
  - Standards
  - Families

Process Types:
- Heavy-weight (rich)
- Light-weight
  - Lean
  - Agile
  - Kanban
Agile Process
Agile Process

Scrum

eXtreme Programming (XP)
Scrum Elements – Process, Artifacts, Roles

http://www.scrumforteamsystem.com/processguidance/v1/Scrum/Scrum.html
13 XP Practices

Project Cycle
- Planning Game (Poker)
- Small Releases
- Whole Team
- Customer Tests

Development Cycle
- Simple Design
- Pair Programming
- TDD (Unit Test)
- Refactoring

Supporting Practices
- Coding Standard
- Sustainable Pace (40-hour week)
- Metaphor (Common Understanding)
- Continuous Integration
- Collective Ownership

Processes

Whole Team
(On-site Customer)

Collective Ownership
Test-Driven Development
Coding Standard

Pair Programming
Simple Design
Sustainable Pace

Refactoring
Continuous Integration

Small Releases
(Short Increments)
Comparison of Basic Process Types

Functionality

Time

Waterfall

Requirements

Design

Implementation

Testing

Incremental, e.g. RUP

Agile - XP

RUP = Rational Unified Process
XP = Extreme Programming
Survey – Software Development Processes and Practices

- 26 Countries

- 500+ Responses (from Industry!)

- URL: https://helenastudy.wordpress.com
Process Frameworks Used in 26 Countries

1. Scrum
2. Iterative Development
3. Kanban
4. DevOps (CI/CD)
5. Classic Waterfall
Process Frameworks Used in Estonia

1. Scrum
2. DevOps (CI/CD)
3. Iterative Development
4. Kanban
5. XP
Process Frameworks Used in Sweden

1. Scrum
2. Iterative Development
3. Kanban
4. Classic Waterfall
5. XP
Company Sizes of Respondents: Estonia vs. Sweden vs. 26 Countries

Company Size
What is your company’s size in equivalent fulltime employees (FTEs)?

All the countries
- Not Answered: 23.95%
- Micro (<10 employees): 14.97%
- Small (11 - 50 employees): 21.76%
- Medium (51 - 250 employees): 27.54%
- Large (251 - 2499 employees): 8.33%
- Very Large (>2500 employees): 11.58%

Estonia
- Not Answered: 7.69%
- Micro (<10 employees): 8.33%
- Small (11 - 50 employees): 41.67%
- Medium (51 - 250 employees): 38.46%
- Large (251 - 2499 employees): 4.67%

Sweden
- Not Answered: 7.69%
- Micro (<10 employees): 7.69%
- Small (11 - 50 employees): 46.15%
- Medium (51 - 250 employees): 23.95%
- Large (251 - 2499 employees): 14.97%
- Very Large (>2500 employees): 11.58%
Software Engineering

Consistent application of engineering principles and methods to the development of software (intensive) systems

Engineering:
Application of systematic (i.e., predictable, repeatable, scalable) procedures
- with well-defined goals (e.g., quality, functionality/scope, cost, time)
- with well-defined/structured products, processes, and organization
Adherence to existing body of knowledge
Observation of constraints (standards, time/cost/quality requirements, etc.)
Development and use of models

Magic Triangle

Product

Quality / Scope

Effort (Cost)

Time

Trade-offs!
Magic Triangle of SE

- **Quality / Scope**
- **Effort (Cost)**
- **Time**

**Magic Triangle**

**Trade-offs!**

- **6 Quality Characteristics** (ISO 9126 / ISO 25000):
  - Functionality
  - Reliability
  - Usability
  - Efficiency
  - Maintainability
  - Portability

- **Effort/Cost and Time**:
  - Development
  - Maintenance
Software Engineering

A bridge from customer/user needs to software product

Customer, User Needs

Developer (SW Engineer)

Software Product/ System

Software Engineering
Next Lecture

• Date/Time:
  • Friday, 11-Sep, 10:15-12:00

• Topic:
  • Requirements Engineering I  ➔  1st Homework!

• For you to do:
  • Have a look at the course wiki
  • Make sure you know to which lab group you have been enrolled + start forming project teams
  • MOST IMPORTANTLY: Go to the labs next week!