

# Design Patterns and Frameworks (DPF) Announcements

Prof. Dr. U. Aßmann  
Chair for Software Engineering  
Faculty of Computer Science  
Dresden University of Technology  
WS 11/12-0.1, 10/8/11



Design Patterns and Frameworks, © Prof. Uwe Aßmann

1

## Elements of the Course

- ▶ Lecturing
  - Do not miss one, they should give you a short and concise overview of the material
- ▶ Reading
- ▶ Exercise sheets
  - Handed out every 2<sup>nd</sup> week
  - You have one week to solve them on your own
  - After that, solutions will be explained in the exercise seminars (Große Übungen)
- ▶ <http://st.inf.tu-dresden.de> -> Teaching -> Design Patterns and Frameworks
- ▶ <http://st.inf.tu-dresden.de/teaching/dpf>

# Reading Along the Lectures

- ▶ Unfortunately, the course is not covered by any book
  - Only about 25-30% is covered by GOF
- ▶ You have to read several research papers, available on the internet
  - Marked by “Mandatory Literature (To Be Read)”
- ▶ Secondary Literature is non-mandatory, but interesting reading.
  - Can be done during the course
- ▶ Other Literature is not to be read, but also interesting.

# Literature (To Be Read)

- ▶ During the course, read the following papers, if possible, in sequential order. See also literature web page.
  - Every week, read about 1 paper (3-4h work)
- ▶ Start here:
  - A. Tesanovic. What is a pattern? Paper in Design Pattern seminar, IDA, 2001. Available at home page.
  - Brad Appleton. Patterns and Software: Essential Concepts and terminology.  
<http://www.cmcrossroads.com/bradapp/docs/patterns-intro.html> Compact introduction into patterns.
- ▶ K. Beck, J. Coplien, R. Crocker, L. Dominick, G. Meszaros, F. Paulisch, J. Vlissides. Industrial Experience with Design Patterns Int. Conference on Software Engineering (ICSE) 1996.  
<http://citeseer.ist.pst.edu/beck96industrial.html>

# Literature (To Be Read)

- ▶ [GOF, Gamma] E. Gamma, R. Helm, R. Johnson, J. Vlissides: Design Patterns. Addison-Wesley 1995. Standard book belonging to the shelf of every software engineer.
  - Chapters on Design Patterns in as far as they are handled in the lectures
  - The book is called GOF (Gang of Four), due to the 4 authors
- ▶ Alternatively to GOF can be read:
  - Head First Design Patterns. Eric Freeman & Elisabeth Freeman, mit Kathy Sierra & Bert Bates. O'Reilly, 2004, ISBN 978-0-596-00712-6
  - German Translation: Entwurfsmuster von Kopf bis Fuß. Eric Freeman & Elisabeth Freeman, mit Kathy Sierra & Bert Bates. O'Reilly, 2005, ISBN 978-3-89721-421-7
- ▶ Alternatively, available at home page. If you have already studied GOF, do not read these. These paper stem from a Design Pattern seminar at Linköpings Universitet, IDA, 2001:
  - A. Tesanovic. What is a pattern?
  - T. Panas. Design Patterns, A Quick Introduction. (on Composite, Visitor)
  - Veaceslav Caisin. Creational Patterns.
  - P. Pop. An overview of the automation of patterns.

# Literature (To Be Read)

- ▶ D. Riehle, T. Gross. Role Model Based Framework Design and Integration. Proc. 1998 Conf. On Object-oriented Programming Systems, Languages, and Applications (OOPSLA 98) ACM Press, 1998. <http://citeseer.ist.pst.edu/riehle98role.html>
- ▶ D. Bäumer, G. Gryczan, C. Lilienthal, D. Riehle, H. Züllighoven. Framework Development for Large Systems. Communications of the ACM 40(10), Oct. 1997. <http://citeseer.ist.pst.edu/bumer97framework.html>
- ▶ D. Bäumer, D. Riehle, W. Silberski, M. Wulf. Role Object. Conf. On Pattern Languages of Programming (PLOP) 97. <http://citeseer.ist.pst.edu/baumer97role.html>

# Literature (To Be Read)

- W. Pree. Framework Development and Reuse Support. In Visual Object-Oriented Programming, Manning Publishing Co., editors M. M. Burnett and A. Goldberg and T. G. Lewis, Pp, 253-268, 1995. [www.softwaresearch.net/publications/J003.pdf](http://www.softwaresearch.net/publications/J003.pdf)
- Or: D. Karlsson. Metapatterns. Paper in Design Pattern seminar, IDA, 2001. Available at home page.
- ▶ D. Riehle, H. Züllighoven. A Pattern Language for Tool Construction and Integration Based on the Tools&Materials Metaphor. PLOP I, 1995, Addison-Wesley. <http://citeseer.ist.pst.edu/riehle95pattern.html>

# Secondary Literature

- ▶ M. Fowler. Refactoring. Addison-Wesley, 1999.
- ▶ D. Riehle, H. Züllighoven, Understanding and Using Patterns in Software Development. Theory and Practice of Object Systems, 1996 <http://citeseer.ist.pst.edu/riehle96understanding.html>
- ▶ D. Garlan, R. Allen, J. Ockerbloom. Architectural mismatch – or why it is so hard to build systems out of existing parts. Int. Conf. On Software Engineering (ICSE 95). <http://citeseer.ist.pst.edu/garland95architectural.html>
- ▶ A. Abel. Design Pattern Relationships and Classification. Paper in Design Pattern seminar, IDA, 2001. Available at home page.
- ▶ T. Pop. Multi-Paradigm Design. Paper in Design Pattern seminar, IDA, 2001. Available at home page.

# Other Literature

- ▶ T. Reenskaug, P. Wold, O. A. Lehne. Working with objects Manning.
  - The OOram Method, introducing role-based design, role models and many other things. A wisdom book for design. Out of print. Preversion available on the internet at <http://heim.ifi.uio.no/~trygver/documents/book11d.pdf>
- ▶ K. Beck. Extreme Programming. Addison-Wesley.
- ▶ H. Allert, P. Dolog, W. Nejd, W. Siberski, F. Steimann. *Role-Oriented Models for Hypermedia Construction – Conceptual Modelling for the Semantic Web*. citeseer.org.

## Please, Please Be Aware – There Will Be Pain!

- ▶ **This course is a research-oriented course**
- ▶ **It treats rather advanced material, the most recent sugar sweets of object-oriented software engineering**
- ▶ **No book exists on all of that at all**
  - GOF covers only about 25-30%
  - Please, collaborate! Read the articles, ask questions!
  - Do the exercise sheets
- ▶ **Warning: The oral exams can only be done if you have visited all lectures and solved all exercise sheets**
  - **The GOF Book alone is not sufficient**
- ▶ **Learn continuously!**
- ▶ **Be aware: you have not yet seen larger systems**
  - You will see one small system in the labs (< 100KLOC)
  - Middle-size systems start over 100KLOC

# Learning Java with the Praktomat

- ▶ In our basic course on software technology, we have published a web-based self-learning system for Java
  - into which you can enter Java programs
  - which tests style and syntax of the programs
  - and runs a test suite against your program
- ▶ The praktomat gives you feedback about your programming abilities in Java
- ▶ The Praktomat is an opportunity for you, please use it!
- ▶ Students without FRZ-account, please register by emailing to [Sebastian.Richly@tu-dresden.de](mailto:Sebastian.Richly@tu-dresden.de)

<http://praktomat.inf.tu-dresden.de/>

## The Positive Side

- ▶ If you follow carefully, you will discover an exciting world of beauty in software
- ▶ If you know all the patterns of the course, you will be a much better software engineer than the standard programmer
  - Most of the work has been discovered in the last 8-10 years, and is unknown to the programmers
- ▶ You will also be a much better manager,
  - because patterns and frameworks teach you how to master large systems and product lines in your company
- ▶ Confession: If I myself had known all these patterns in 1998, my life would have been much easier
- ▶ The gain is worthwhile the pain!

# Design Patterns and Frameworks

## DPF

## Goals

Prof. Dr. U. Alßmann

Chair for Software Engineering

Faculty of Informatics

Dresden University of Technology



Design Patterns and Frameworks, © Prof. Uwe Alßmann

13

## Main Goals

- ▶ Know several different kinds of patterns
  - Basic kinds of incentives for design patterns
- ▶ Explain patterns for variability, extensibility of systems
- ▶ Understand frameworks and product lines better
- ▶ Explain systematic structures for systems with 100KLOC
  - Layered frameworks
  - Facets
- ▶ Understand a different way of object-oriented design
  - Role-based design



# Standard Problems to Be Solved By Design Patterns

- ▶ Variability
  - Exchanging parts easily
  - Variation, complex parameterization
  - Static and dynamic
  - For product lines, framework-based development
- ▶ Extensibility
  - Software must change
- ▶ Glueing (bridging, adapting, connecting)
  - Overcoming architectural mismatches
  - Coupling software that was not built for each other
- ▶ Others:
  - Optimization: making things more efficient
    - Antagonistic to flexibility
  - Structuring of interactive applications
    - Grasping common patterns of flow in software systems

## Goal: Variability Patterns

- ▶ Variability (Variation, Exchange, Parameterization)
  - Expressing commonality and variability
  - We fix a common part (a *framework*) and parameterize it at *variation points* (*variability*)
  - *Framework instantiation patterns* describe variation of frameworks
- ▶ Understanding Templates and Hooks
  - Template Method vs Template Class
  - Dimensional Class Hierarchy, Bridge
- ▶ Understanding creational patterns
  - Factory Method, Factory Class, Builder
- ▶ Variability design patterns for frameworks
- ▶ Variability concerns
  - Exchange of communication
    - Dynamic call (e.g., ChainOfResponsibility)
  - Exchange of policy
  - Exchange of material in data-based applications



# Goal: Extensibility Patterns

- ▶ Extensibility
  - For new, unforeseen product variants
  - For evolution
  - For dynamic change
- ▶ Understanding extensibility patterns
  - ObjectRecursion vs TemplateMethod, Objectifier (and Strategy)
  - Decorator vs Proxy vs Composite vs ChainOfResponsibility
  - Visitor, Observer (EventBridge)
- ▶ Parallel class hierarchies as implementation of facets
  - Understand facets as non-partitioned subset hierarchies
  - Layered frameworks as a means to structure large systems, based on facets
- ▶ Template/Hook Extension:
  - Code skeletons are *extended* at *hooks*
  - Frameworks can have hooks that can be extended (beyond variation)
- ▶ Framework extension patterns

# Goal: Glueing Patterns for Overcoming Architectural Mismatches

- ▶ Glue patterns
  - Understand architectural mismatch
  - Understand patterns that bridge architectural mismatch
- ▶ Adaptation, bridging, connections
  - Of communication protocols
  - Between heterogeneous components (different representations, different locations, different control flow structure)
- ▶ Anonymous communication
  - For exchange of communicators
- ▶ Scalable communication
  - At runtime, in distributed systems

# Goal: A Basic Tool: Role Modelling

- ▶ For all of that, a basic tool set is role modelling
  - Which roles does an object play in the application?
- ▶ It tells how design patterns occur in applications
  - Invented by Reenskaug. Summarized in the book “Working with Objects”, 1995
- ▶ Role-model based design
  - Why design patterns are role models of class diagrams
  - Understand the difference between roles and objects, role types and classes
  - Understand role mapping to classes
    - How roles can be implemented
  - Understand role model composition
  - Understand composite design patterns as composition of role models

# Goal: Frameworks Pattern

- ▶ Understand variabilities in frameworks
  - Introducing different types of hooks for frameworks and components (TH patterns)
  - Understanding framework variability patterns
- ▶ Studying extensible framework hook patterns
  - Role Object pattern
  - Layered frameworks, implemented by Role Object
- ▶ Patterns document frameworks
  - Patterns play an important role on how a framework is instantiated
  - Whitebox, blackbox, layered, T&H framework

# Goal: Structuring Interactive Applications with Tools&Materials

- Understand the central metaphors of the Tools-and-Materials architectural style for the construction of interactive applications
  - Know an example of a pattern language
- ▶ Interactive applications can be pretty complex
- ▶ TAM (tools-and-materials, Werkzeug-Automat-Material, WAM) is a *pattern language for interactive applications*
- ▶ Nice metaphors that help thinking, constructing, maintaining interactive applications

## Overview of the Course

Refactoring

Framework Backward Compatibility

Variability-Based Design

**Part III: Refactoring and Symmetries**

Contracts

Documentation

Frameworks with components/models

Eclipse

San Francisco

SAP

**Part II: Frameworking**

Tools & Materials

Layered Frameworks

**Part I: Patterns and Frameworks**

Metapatterns and Framework patterns

Role Models

Composite Patterns

Variability Patterns

Extensibility Patterns

Connection Patterns

**Part 0: Basic Patterns**

Intro

Employment and Usage

The End

