



Design Patterns and Frameworks (DPF) Announcements

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WS 13/14-0.3, 11/16/13



Elements of the Course

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- ▶ Meeting hour of Prof. Aßmann
 - after the course, or Thursday, 11:00-13:00. Please register with secretary Katrin.Heber@tu-dresden.de, thanks.
- ▶ Lecturing
 - Do not miss one, they should give you a short and concise overview of the material
- ▶ Reading
- ▶ Exercise sheets (Dr. Sebastian Götz)
 - Handed out every 2nd 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

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- ▶ 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 or References is non-mandatory, but interesting reading
- ▶ Other Literature is not to be read, but also interesting.

Literature (To Be Read)

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- ▶ 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)

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- ▶ [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)

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- ▶ 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)

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- 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.softwareresearch.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

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- ▶ 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

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- ▶ 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. Nejdl, 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!

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- ▶ **This course is a research-oriented course**
- ▶ **It treats rather advanced material, the most recent sugar sweets of object-oriented software engineering**
- ▶ **There is no book on all of that**
 - 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

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- ▶ 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 ZIH-account, please register by emailing to Sebastian.Richly@tu-dresden.de

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

The Positive Side


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- ▶ 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
 - Your language and communication will improve
- ▶ You will also be a much better software architect,
 - because patterns are good design knowledge
- ▶ and 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!

Running Also in WS Term

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- ▶ Academic Skills for Computer Scientists (3/1/0 SWS, 6cp)
 - In English
 - <http://st.inf.tu-dresden.de/teaching/asics>
 - Preparation of your master's thesis
- ▶ Future-Proof Software Systems (Dr. Frank Furrer, Senior Consultant and EU-Reviewer)
 - Architecture that is stable and can be evolved
 - In English
 - <http://st.inf.tu-dresden.de/teaching/fpss>
- ▶ Softwarewerkzeuge
 - <http://st.inf.tu-dresden.de/teaching/sew>
 - Metamodeling, technical spaces, model mappings, traceability
 - On the transition to English; on demand, I will lecture in English, but many slides are still in German



Design Patterns and Frameworks (DPF) Goals

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Main Goals

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- ▶ 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

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- ▶ Variability: Exchanging parts easily
 - Static and dynamic
 - Variation, complex parameterization
 - For product lines, framework-based development
- ▶ Extensibility
 - Software must change and evolve
- ▶ Connections (Glueing, bridging, adapting)
 - Overcoming architectural mismatches
 - Coupling software that was not built for each other
- ▶ Representation of complex objects
 - Not fitting into one physical location
- ▶ Others Problems:
 - Optimization: making things more efficient
 - Structuring of interactive applications

Goal: Variability Patterns

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- ▶ 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 as variability patterns
 - Factory Method, Factory Class, Builder
- ▶ Variability patterns for frameworks
- ▶ Variability concerns
 - Exchange of communication, Dynamic call
 - Exchange of policy
 - Exchange of material in data-based applications

Goal: Extensibility Patterns

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- ▶ 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

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- ▶ 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

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- ▶ 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

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- ▶ 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

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- 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

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Refactoring

Framework
Backward Compatibility

Variability-Based
Design

**Part III: Refactoring
and Symmetries**

Contracts

Documentation

Frameworks with
components/models

Part II: Frameworking

Eclipse

San Francisco

SAP

Tools & Materials

Layered Frameworks

Part I: Patterns and Frameworks

Metapatterns
and Framework patterns

Role Models

Composite Patterns

Part 0: Basic Patterns

Variability Patterns

Extensibility Patterns

Connection Patterns

Intro

Employment and Usage

The End

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