31. Documentation as Synchronized Dependent Model in a Macromodel

Documentation Generation as App for RAG

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Interesting

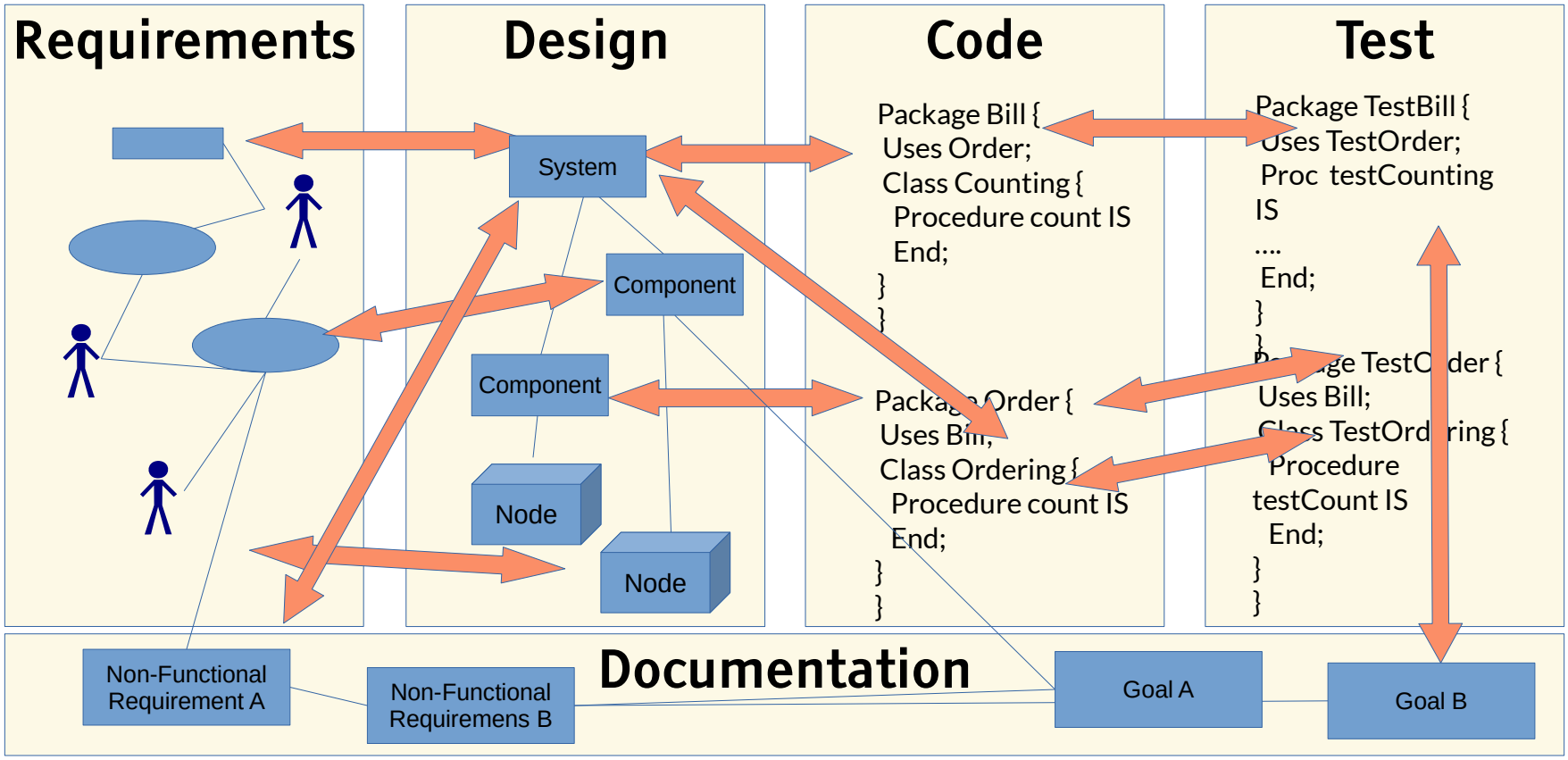
- https://www.writethedocs.org/ is a conference for documentation practicioneers
- https://waset.org/software-implementation-and-software-documentation-conference

31.1 Tasks of Documentation Tools

http://en.wikipedia.org/wiki/Software_documentation

Q12: The ReDoDeCT Problem and its Macromodel

- The **ReDoDeCT problem** is the problem how requirements, documentation, design, code, and tests are related (→ V model)
- Mappings between the Requirements model, Documentation files, Design model, Code, Test cases
- A **ReDoDeCT macromodel** has maintained mappings between all 5 models



Basics of Software Documentation

- Documentation is a means of **communication** to keep software alive
  - between developers and future developers
  - between coders and testers
  - between developers and managers (for reviews and audits)
- Problems:
  - Documentation ***ages*** because code is modified and evolved (***documentation aging)***
  - Good documentation costs time and money
- Different kinds of documentation:
  - **Generated documentation** is derived from code and models
  - **Integrated Documentation** is derived from the code (e.g., in comments), e.g., JavaDoc
  - **Elucidative Documentation**, derives both from another and keeps it consistent (generative or round-trip engineering)
- Standards:
  - national DIN 66230, 66231, 66232, 66270(1998)
  - international ISO/IEC 6592(2000), ISO/IEC 18019(2004)

Without documentation, a program is not software

Quelle: [24 S. 241 ff.]

Taxonomy of Documentation Documents

- **User documentation** (Benutzerdokumentation) explains the program to end users
  - Tutorials, user handbook, online documentation
- **System documentation** for installation, test cases, code documentation, maintenance, operations
  - **API documentation** documents interfaces of the system or framework, to let programmers use them for writing apps
  - **Architecture documentation** to highlight the architectural structure of the software, e.t., with arc42 (https://www.arc42.de/)
- **Project documentation**
  - Developer documentation
  - Project documentation (project plan, requriements specification, status reports, after study)
- **Quality documentation**
  - Test-, review, audit documentation
- **Process documentation**
  - Standards, processes

Quelle: [24 S. 245 ff.]

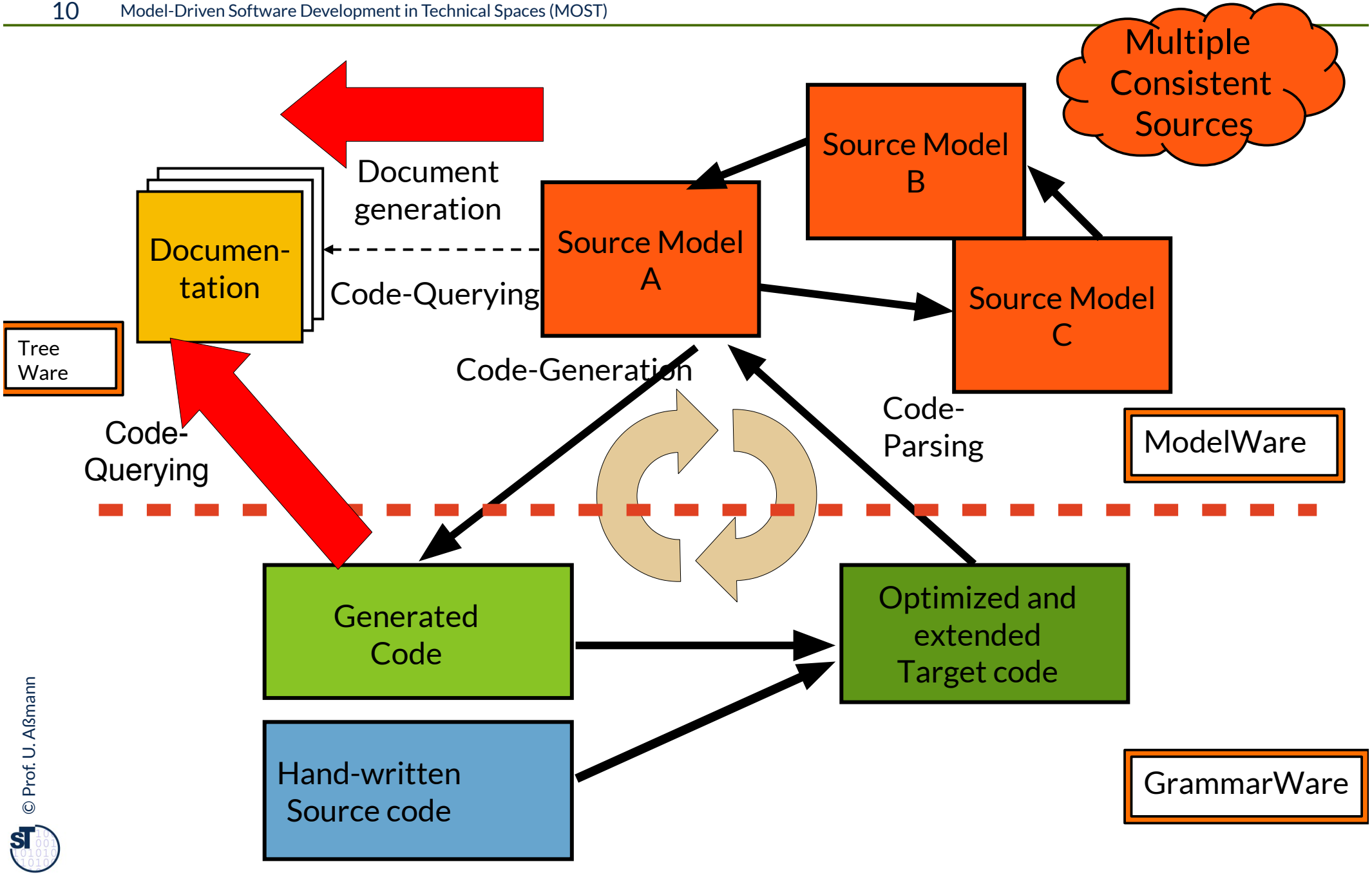
Tasks of Documentation Tools

- Basically, documentation generation is similar to code generation. Documentation is created in higher-order attributes on a link tree by a RAG
- **Documentation generation is an application areas for RAG**
- **Generation** of derived documents from code and models
  - Generation of Word (docx), LibreOffice (odt), rtf, xml, html formats
  - Generation of figures (svg, png, pdf)
  - Generation of snippets and generic snippets
  - Back-linking to originals
- **Filling** of documentation templates (with the hedge-principle)
- **Parameterization** with layouts
  - via css-style sheets

31.2 Generative, Template-Driven Documentation Tools

.. Documentation derived from code and models, based on template-based code generation

Macromodel Principle and Round-Trip Engineering



Documentation Tool JavaDoc is a Template Expander

- JavaDoc reads Java source code and extracts html from the code comments, based on **html templates**
  - Typical hedge-based code generation with generic snippets
- Generation of additional contents and indices
- Controlled by Java metadata attributes
  - @author, @date, @param
- Layouting via plugin classes called *doclets*
- JavaDoc has been realized for all programming languages

[JavaDoc; Wikipedia: http://de.wikipedia.org/wiki/JavaDoc]

JavaDoc is a Typical HRAG Application

- The html documentation is computed in a higher-order synthesized attribute `htmldoc:HTML`

```
// schematic, synthesis from bottom to top
Interpretation javaDoc(Tree → Tree)  {
  Attributions of Root(classes[]) {
    this.htmldoc := map + classes.htmldoc;
    <println(„Result is %S“, this.htmldoc)>
  }
  Attributions of Class(superclass:Class,methods{}) {
     this.htmldoc := <superclass.Name + methods.htmldoc;
  }
  Attributions of Method(name,comment) {
     this.htmldoc := „<h1>“+name+“</h2>“+comment.htmldoc;
  }
  Attributions of Comment(text) {
     this.htmldoc := text;
  }
}
```

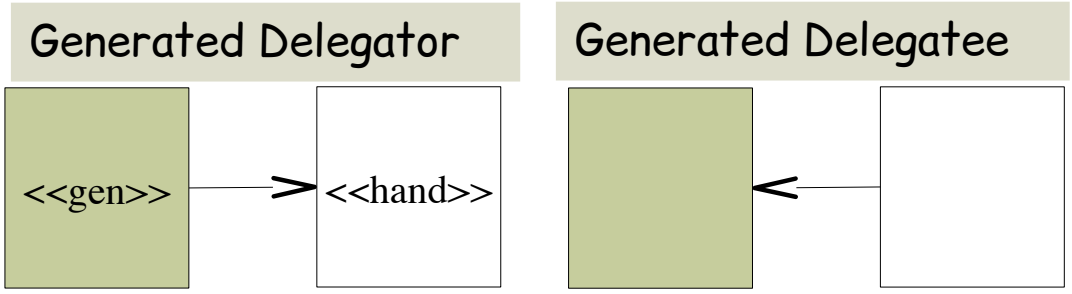
Composition of Separated Hand-Written and Generated Documentation Snippets

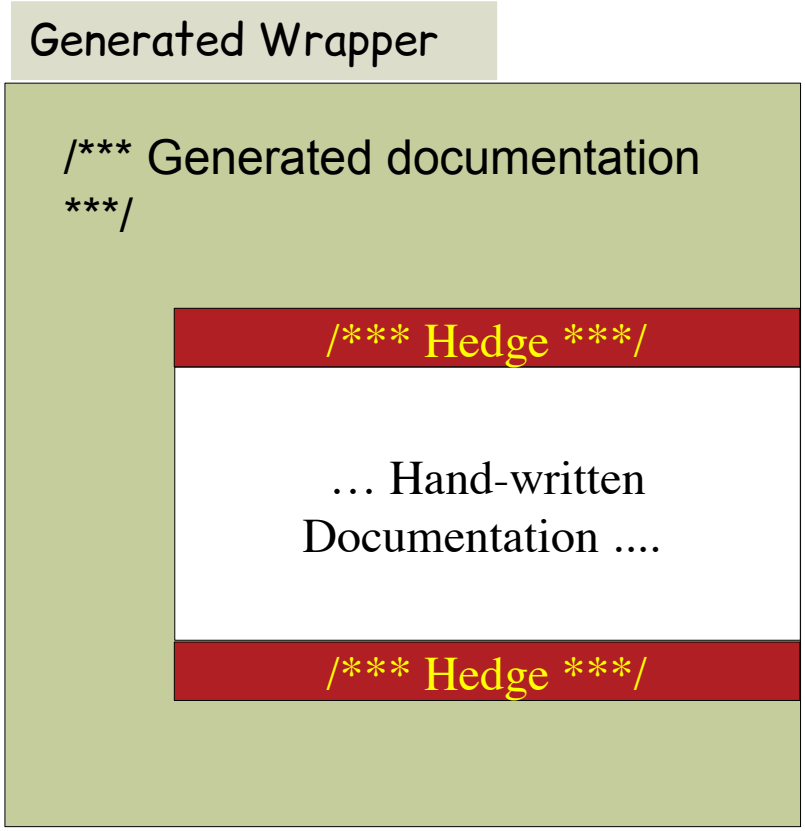
In separate files: Coupling by "include"

- Only possible if document format supports subdocument inclusion
  - e.g., TeX or Framemaker

In one file:

Coupling with **hegdes (Trennmarkierung)**

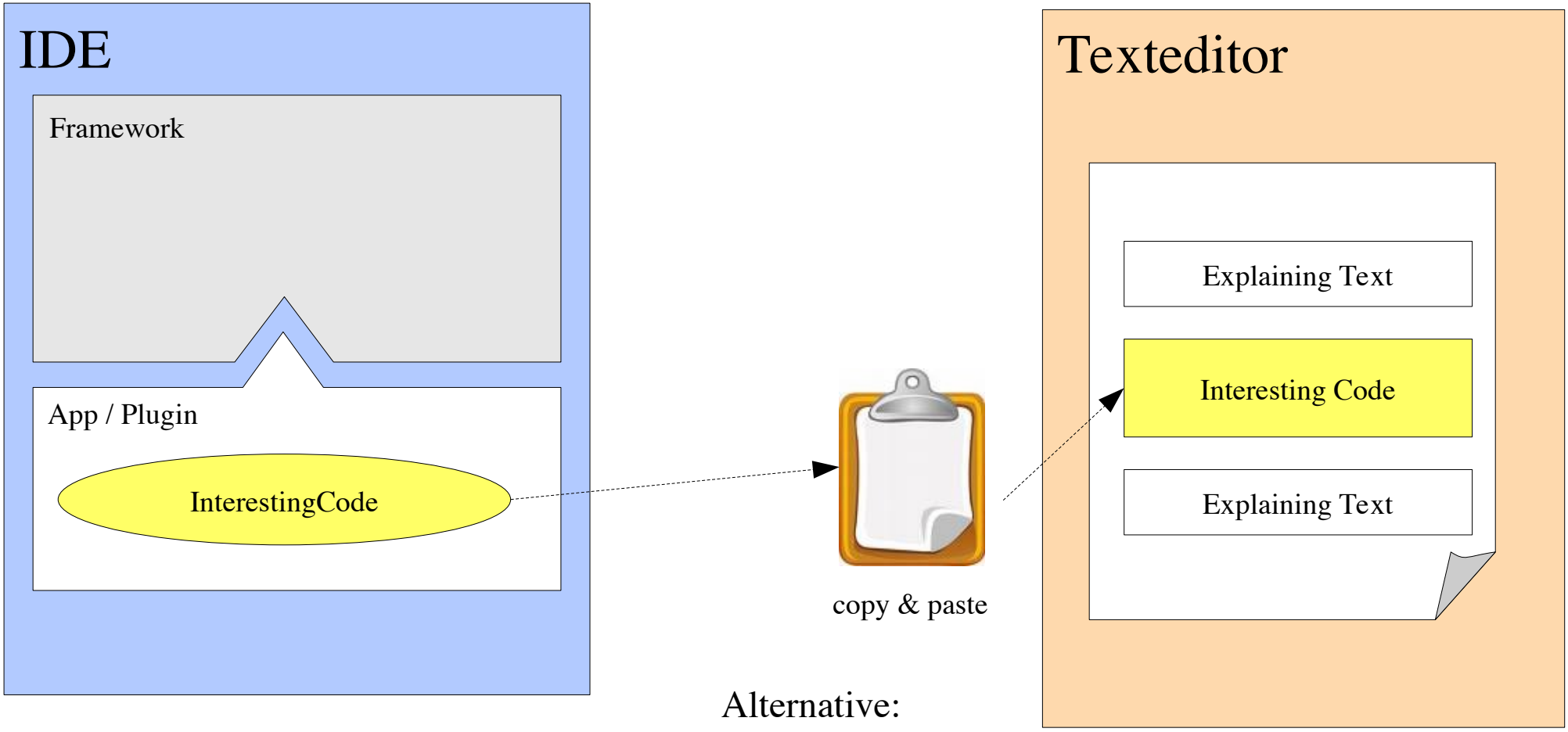




31.3 Literate Programming

- They integrate code, models and documentation by **separating code from documentation**

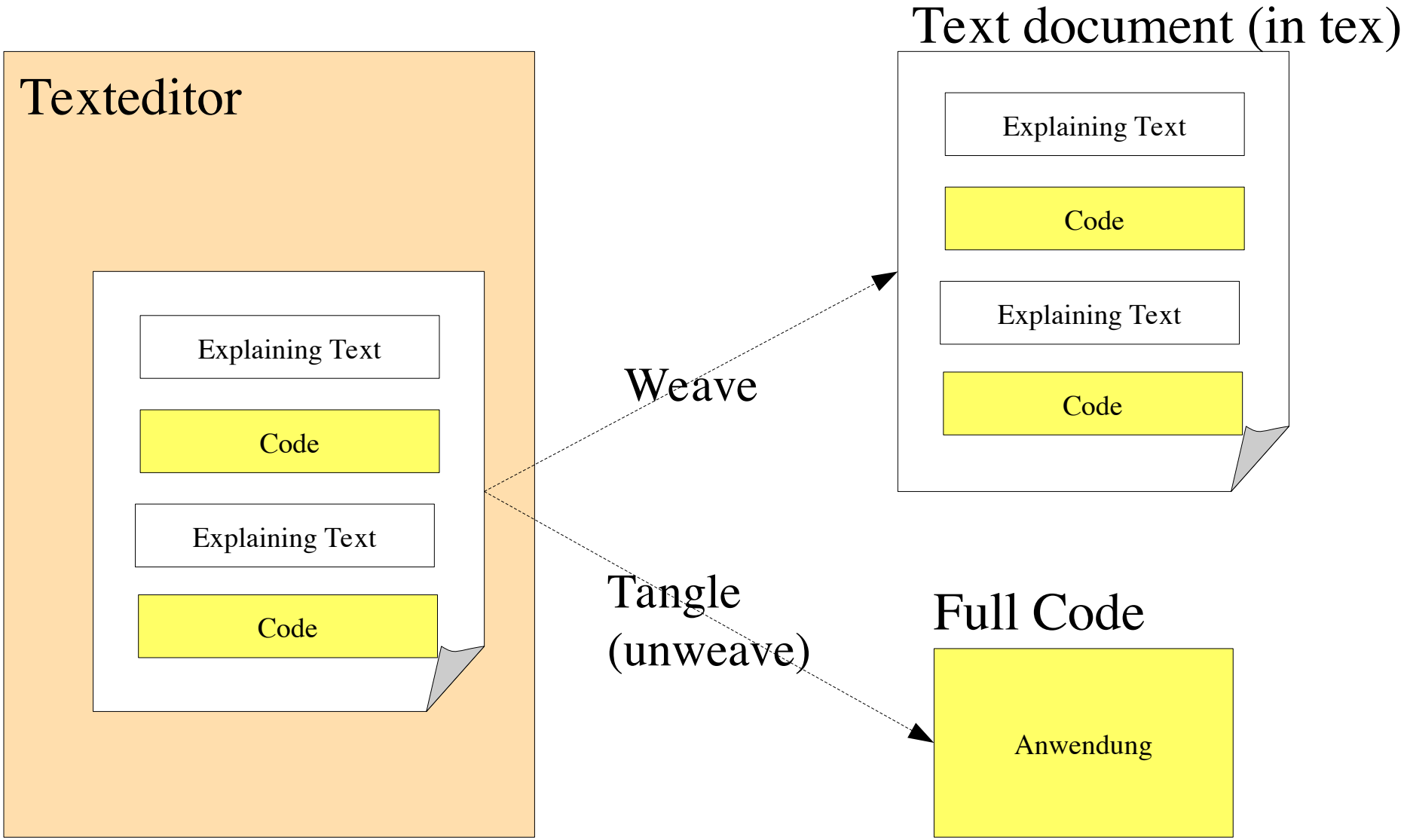
Classic: Manual Writing of Tutorials



Alternative:
Code query
e.g., with
Xcerpt or QL

How to Write Integrated Documentation and Tutorials?

[Knuth] Literate Programming by Code Unweaving



Literate Programming

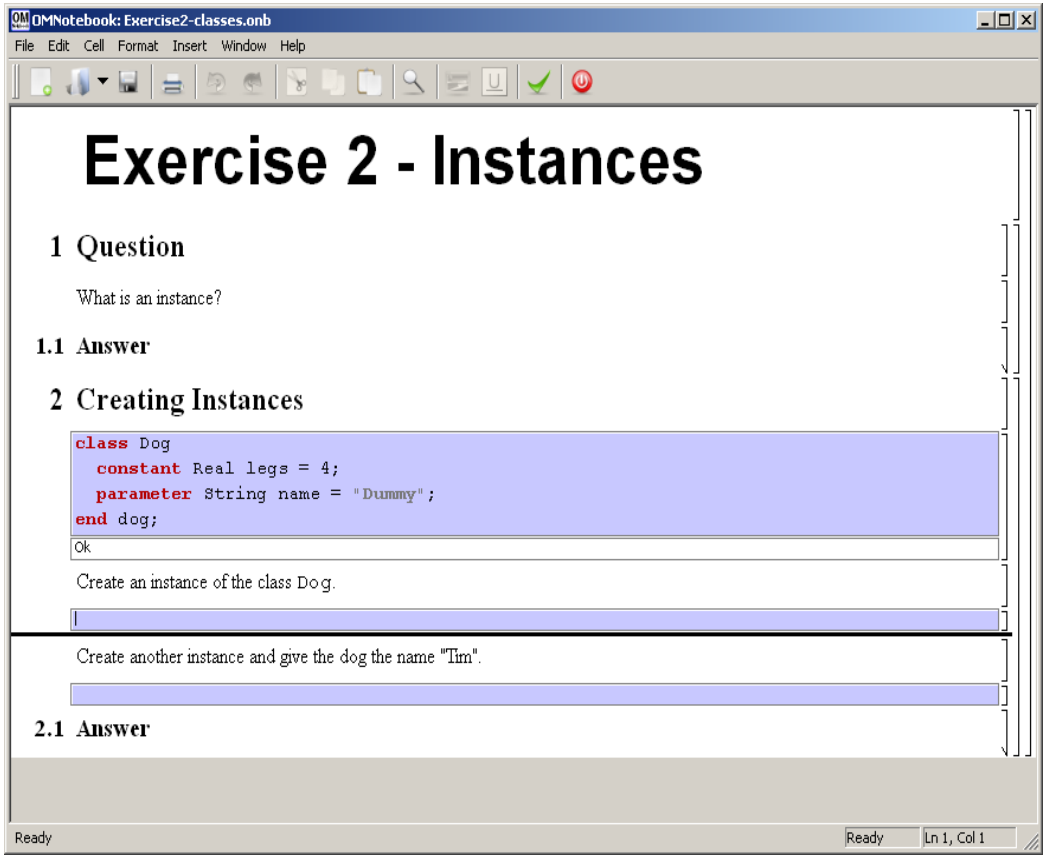
⟦The program text below specifies the "expanded meaning" of ⟨Program to print ... numbers 2⟩; notice that it involves the top-level descriptions of three other sections. When those top-level descriptions are replaced by their expanded meanings, a syntactically correct PASCAL program will be obtained.⟧

```
⟨Program to print the first thousand prime
      numbers 2⟩ ≡
program print_primes(output);
  const m = 1000;
    ⟨Other constants of the program 5⟩
  var ⟨Variables of the program 4⟩
    begin ⟨Print the first m prime numbers 3⟩;
    end.
```

[Literate Programming von Donald E. Knuth]

- The TeX engine is programmed literately
- Overview: http://www.literateprogramming.com/
- OMNotebook/DrModelica: http://www.modelica.org/tools

OMNotebook – Literate Programming with DrModelica

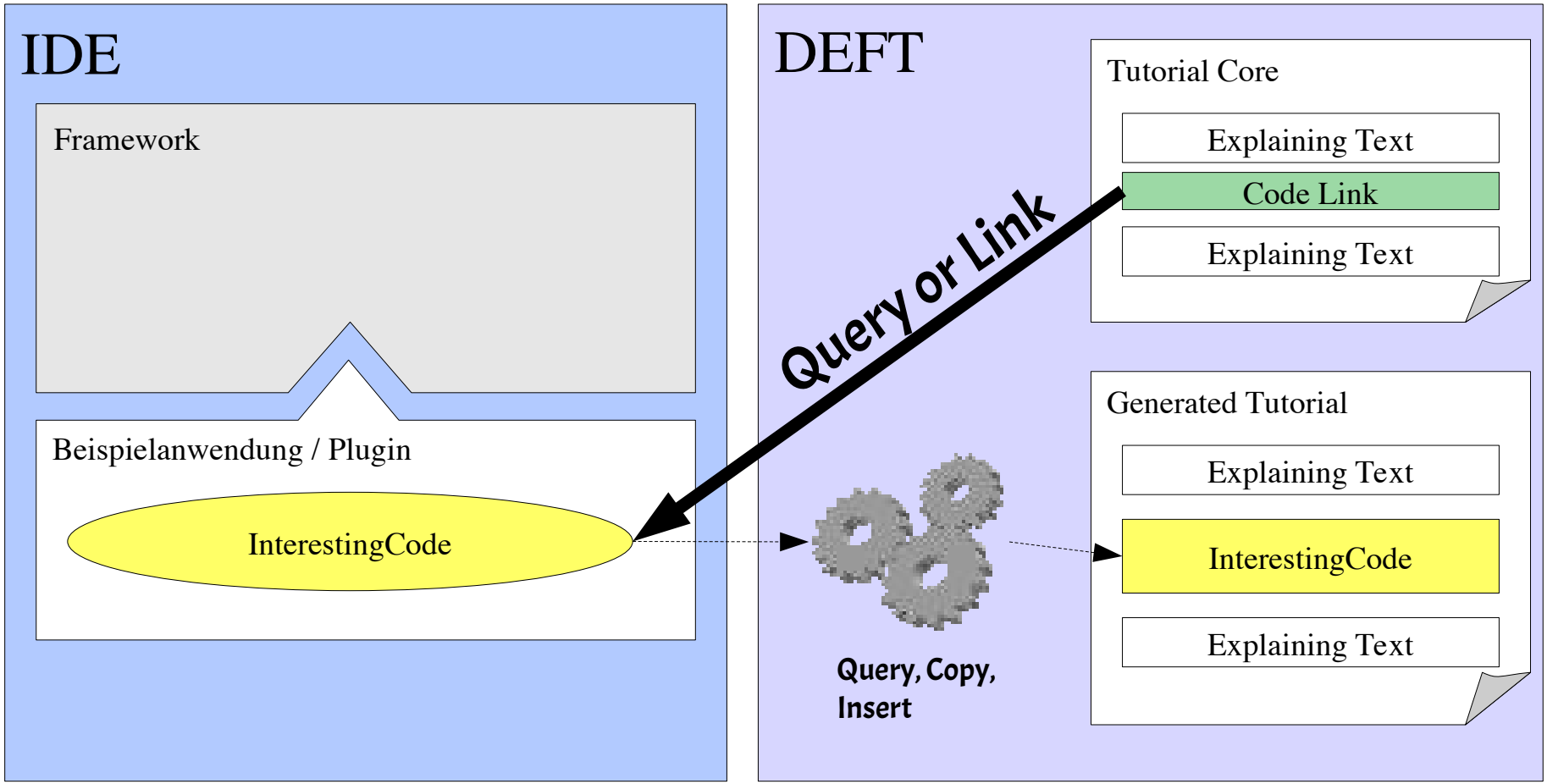


- Linked documents with interactive exercises
- Inspired by DrScheme und DrJava, learning tools for Scheme resp. Java
- www.openmodelica.org

31.4 Elucidative Documentation Tools

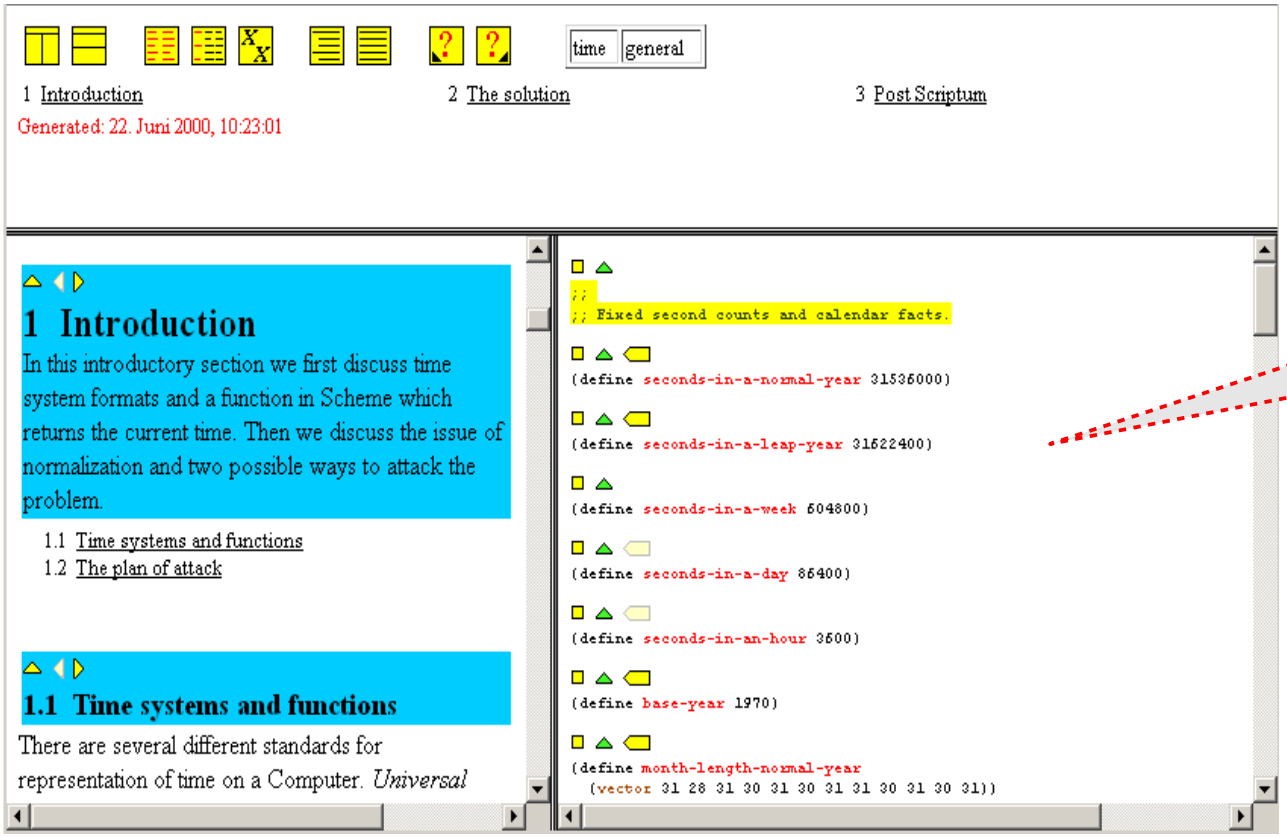
- They link code, models and documentation by **model and code mapping**
- **and renew the documentation by *hot updates***

Elucidative Programming Links Documentation with Queries to Code



hot update
(hot synchronisation):
round-trip engineering

Elucidative Programming

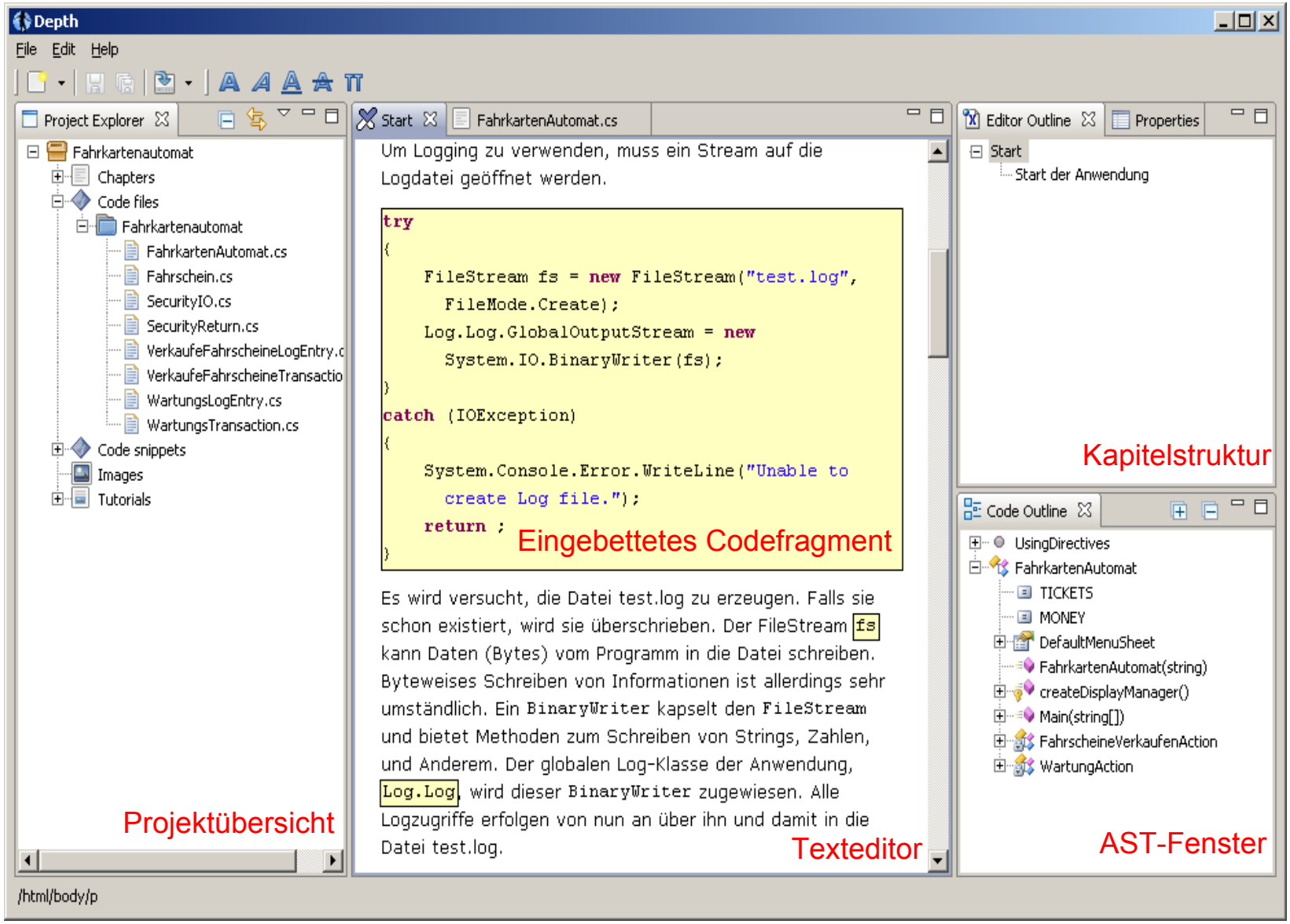


„Scheme Elucidator" Environment

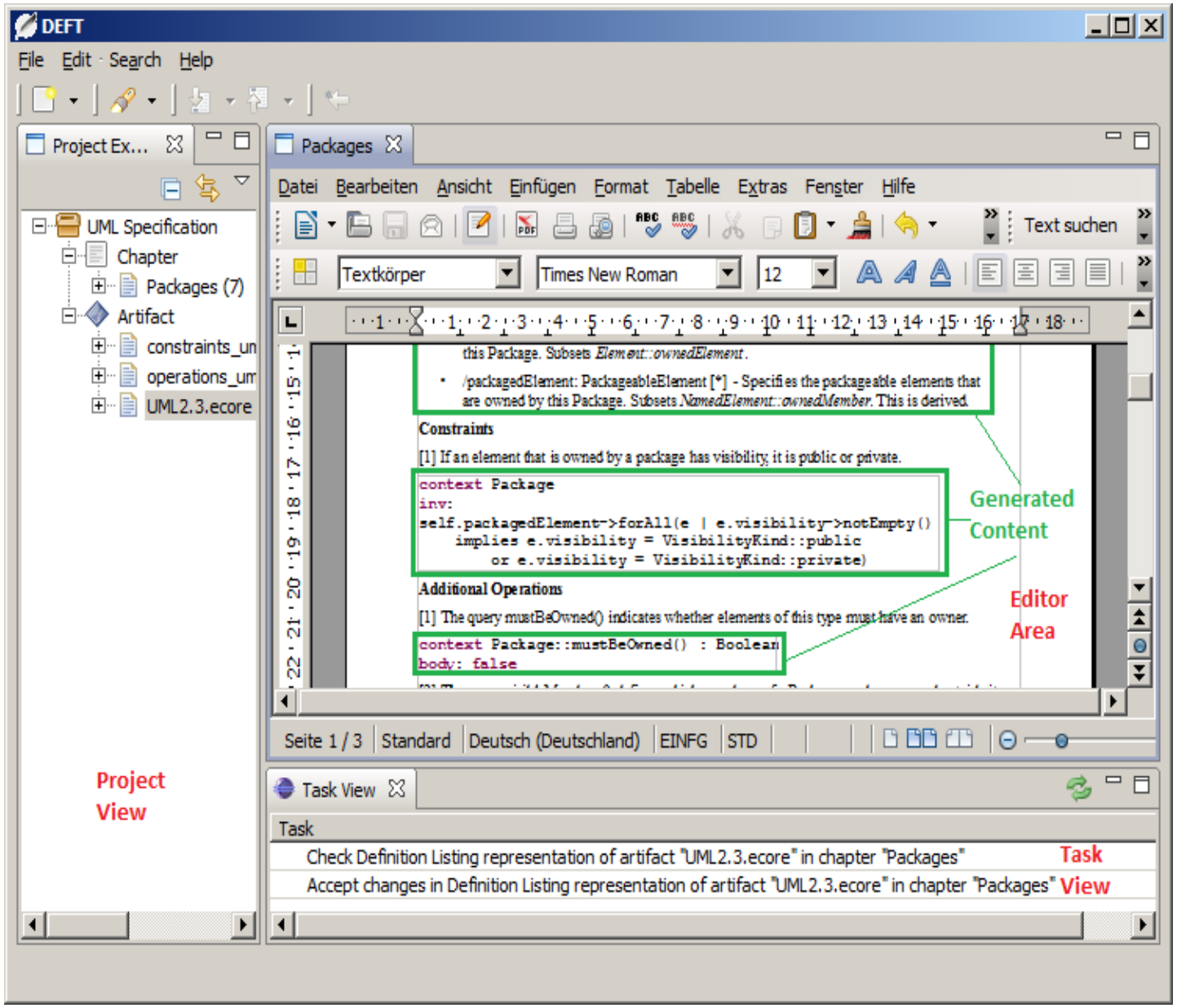
- Elucidative Programming shows documentation and code in parallel
- http://www.cs.aau.dk/~normark/elucidative-programming/
- http://deftproject.org

hot update
(hot synchronisation):
round-trip engineering

Development Environment For Tutorials (DEFT www.deftproject.org)



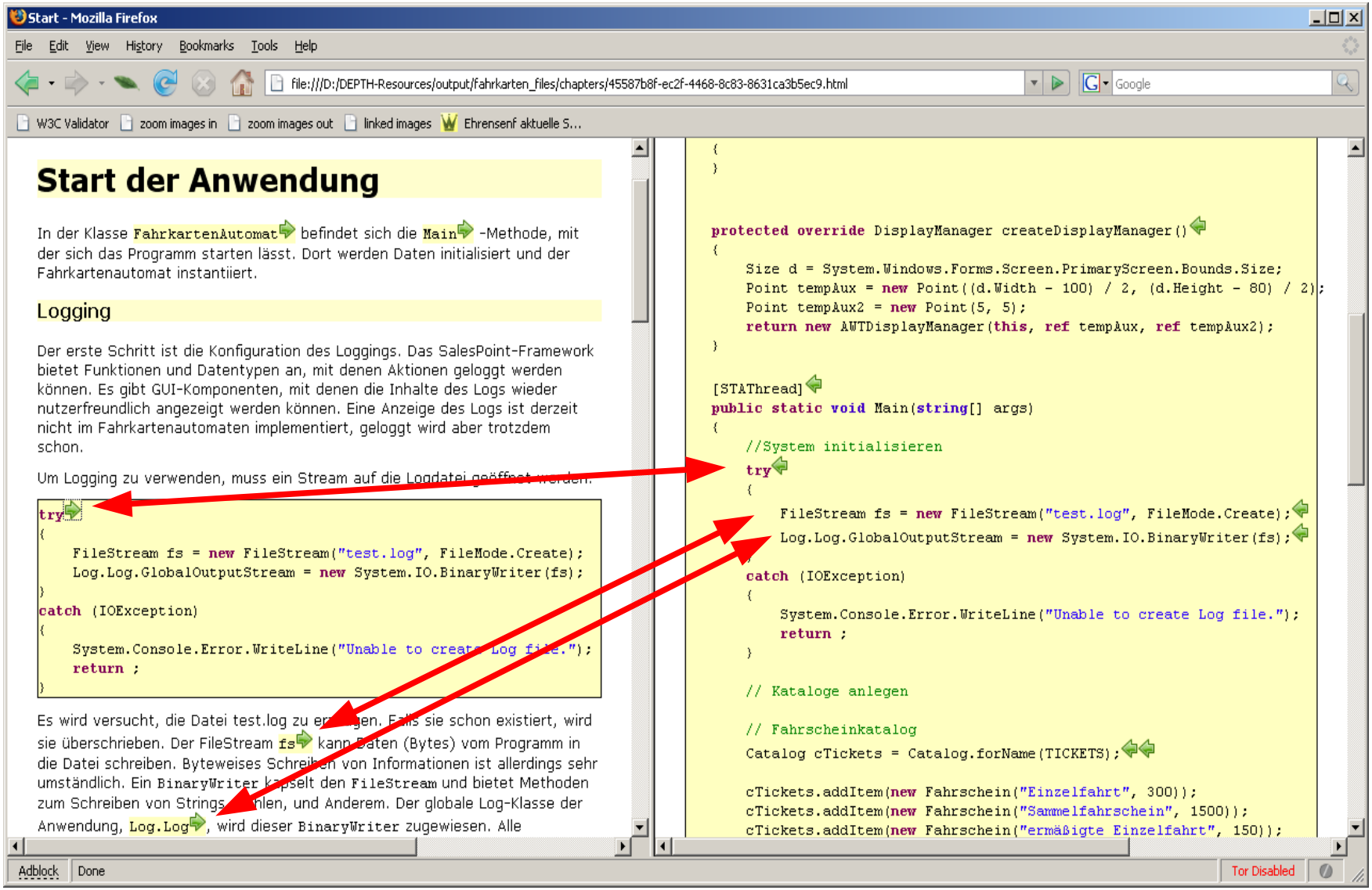
Embedding UML Constraints for UML Models into Documentation



Development Environment For Tutorials (DEFT)

- Eclipse RCP application, language independent
- Management of code, models and text
- Prettyprinting of code fragments from code templates
- Hot update of generated documentation
  - Automatic update of embedded code fragments
  - Notiviation if code fragments have changed

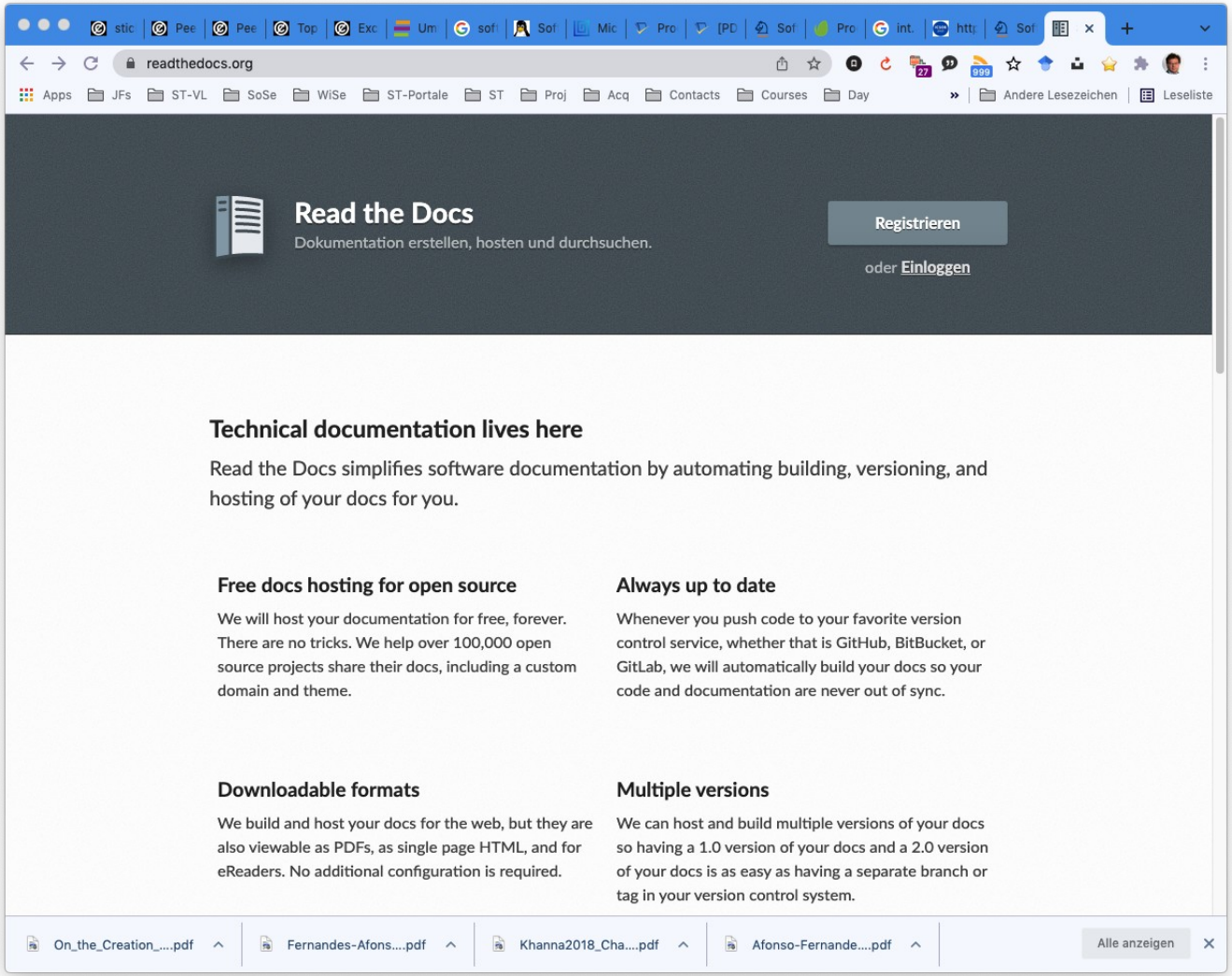
Generated HTML Tutorial



31.5 Web-based Documentation Generators based on Markdown

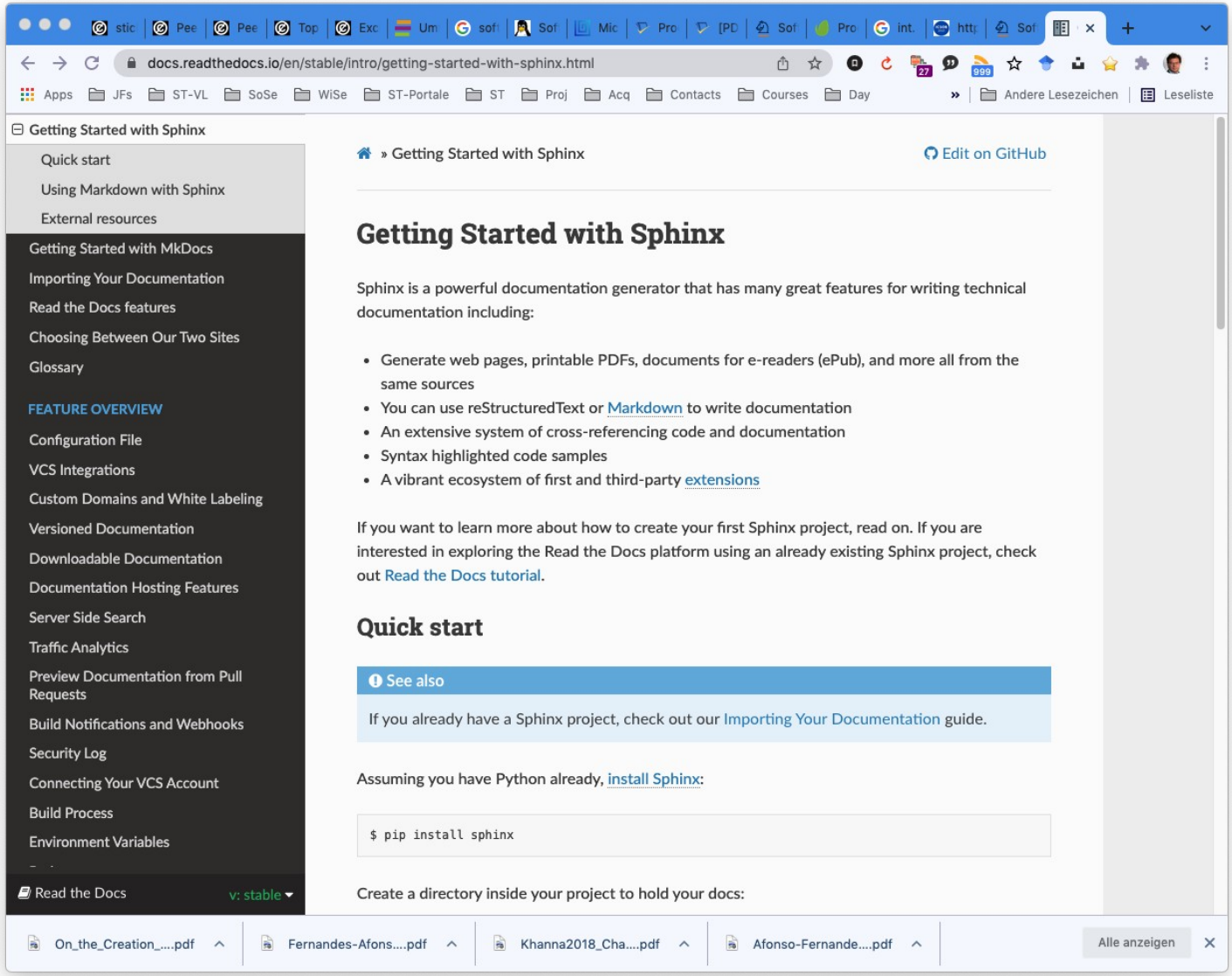
Sphinx and the Documentation Cloud readthedocs.org

- readthedocs is a cloud for documentation projects
- supporting two documentation generators *sphinx* and *mkdocs*



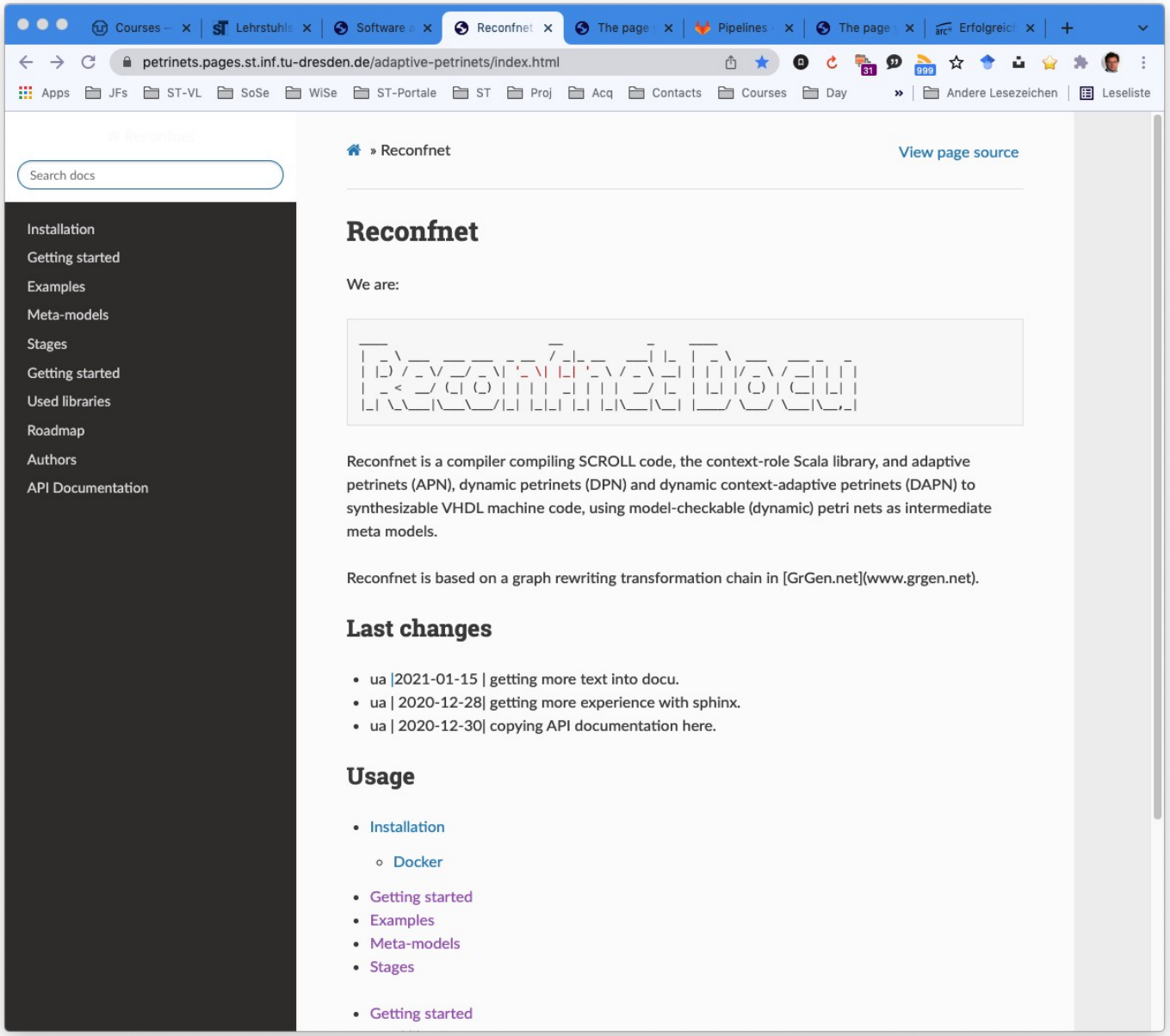
Sphinx

- Architecture documentation
- User documentation
- Files in formats restructuredText and Markdown are transformed to HTML
- Treats entire directories
- many output formats (e.g., Latex)
- Can be coupled with Javadoc or similar API doc generators



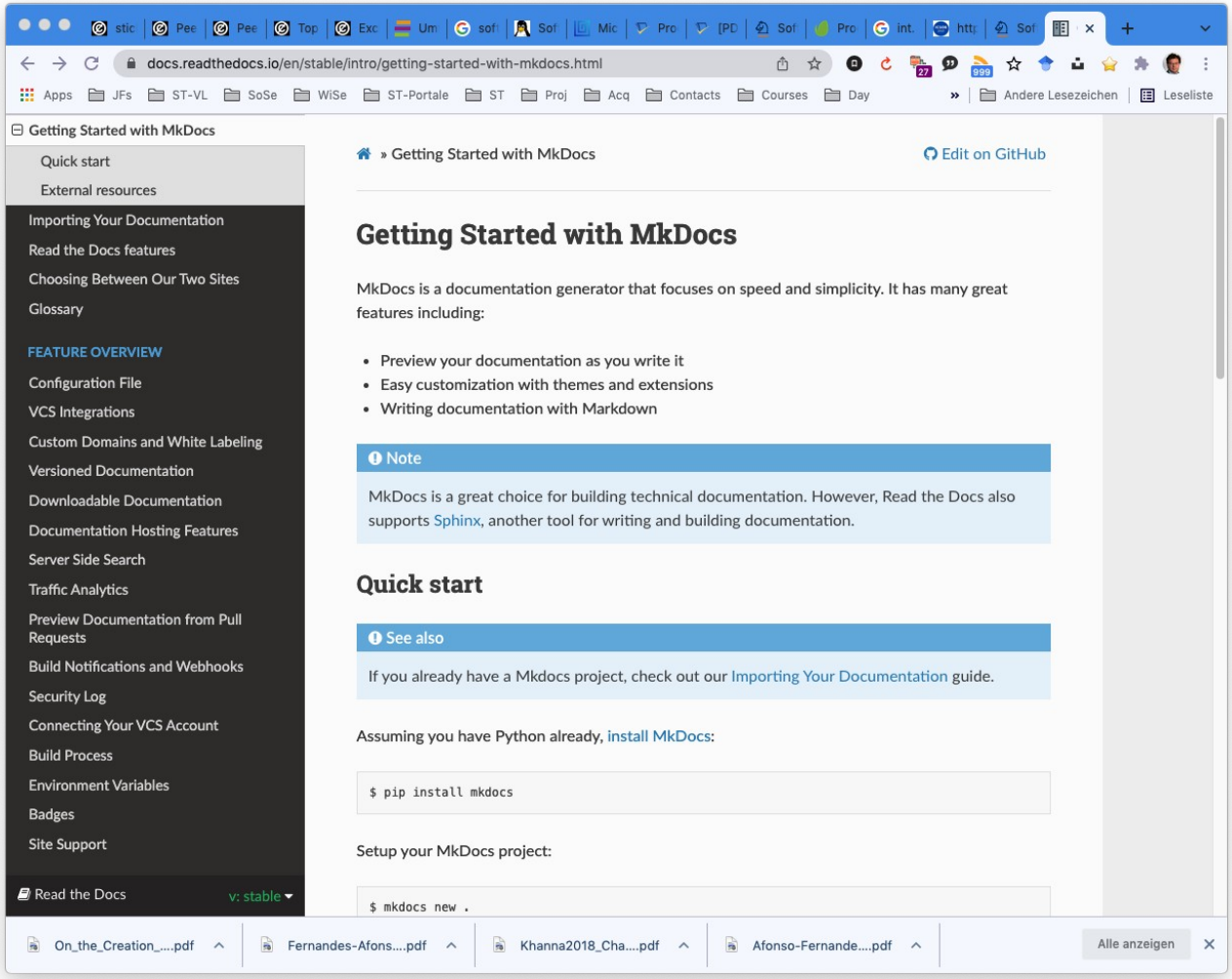
Example Sphinx Project

- Petrinet compiler Reconfnet https://petrinets.pages.st.inf.tu-dresden.de/adaptive-petrinets/index.html
-



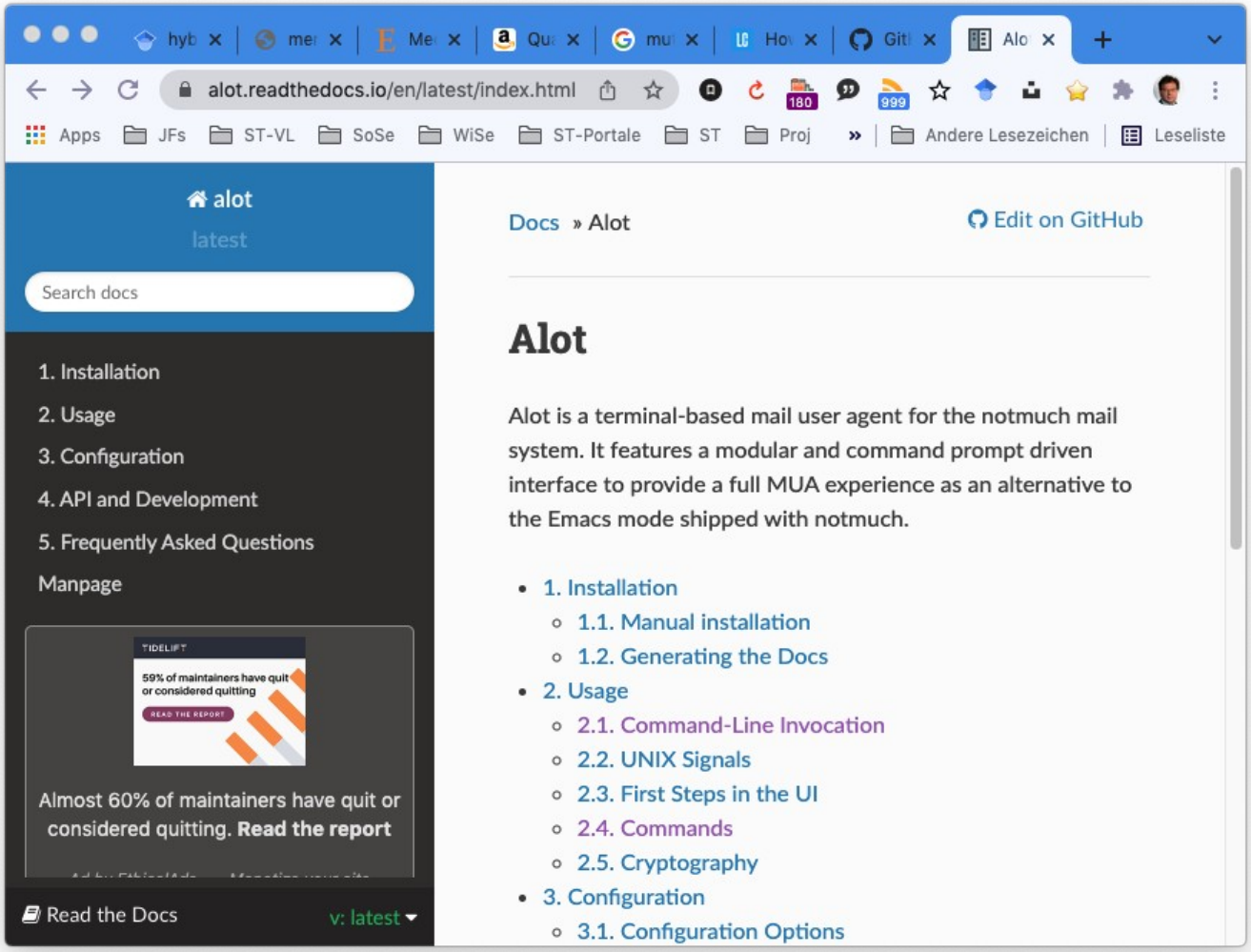
MkDocs

- Markdown files to HTML files
- several output formats



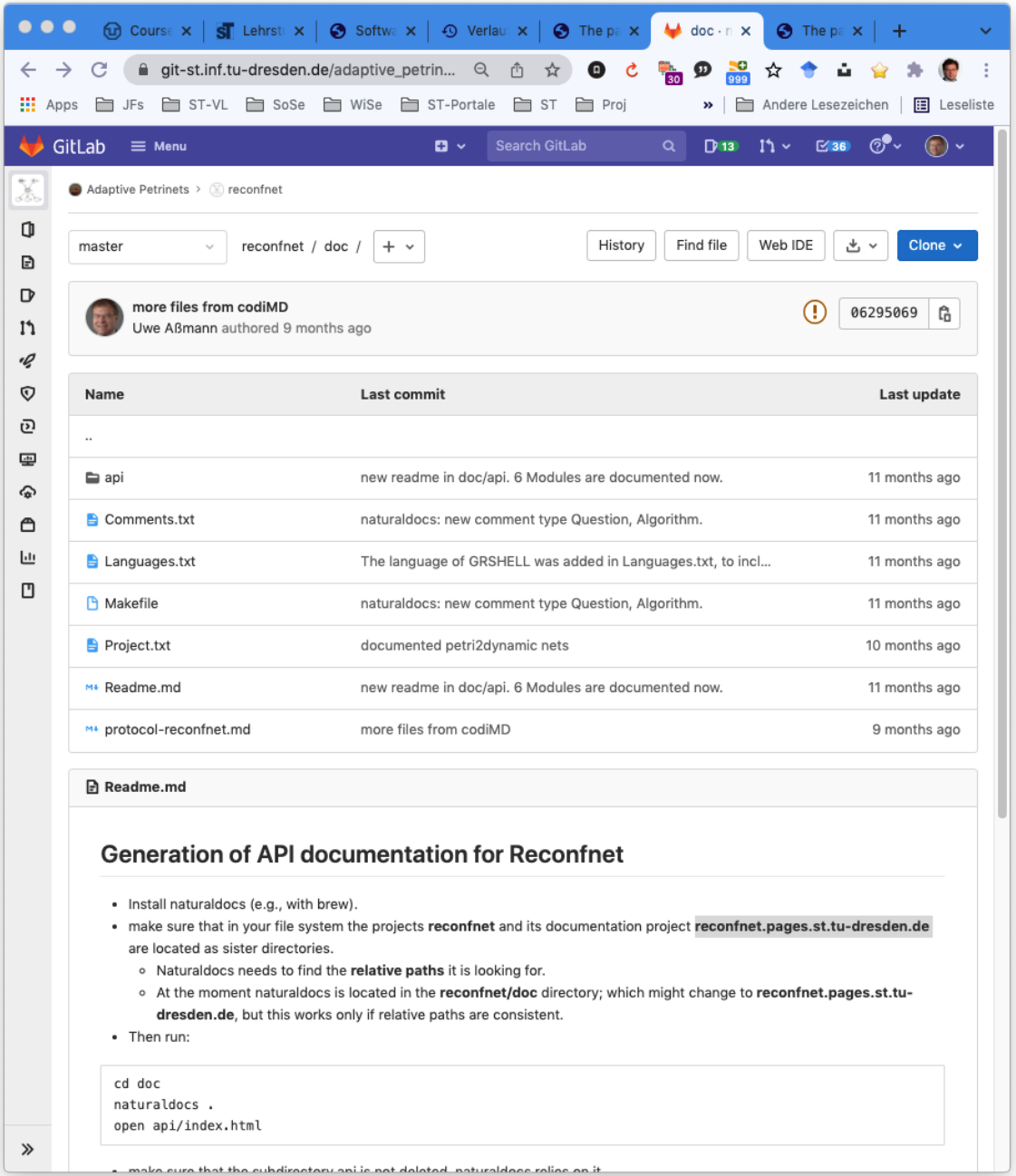
Alot – a Mail User Agent Documented on readthedocs

- https://alot.readthedocs.io/



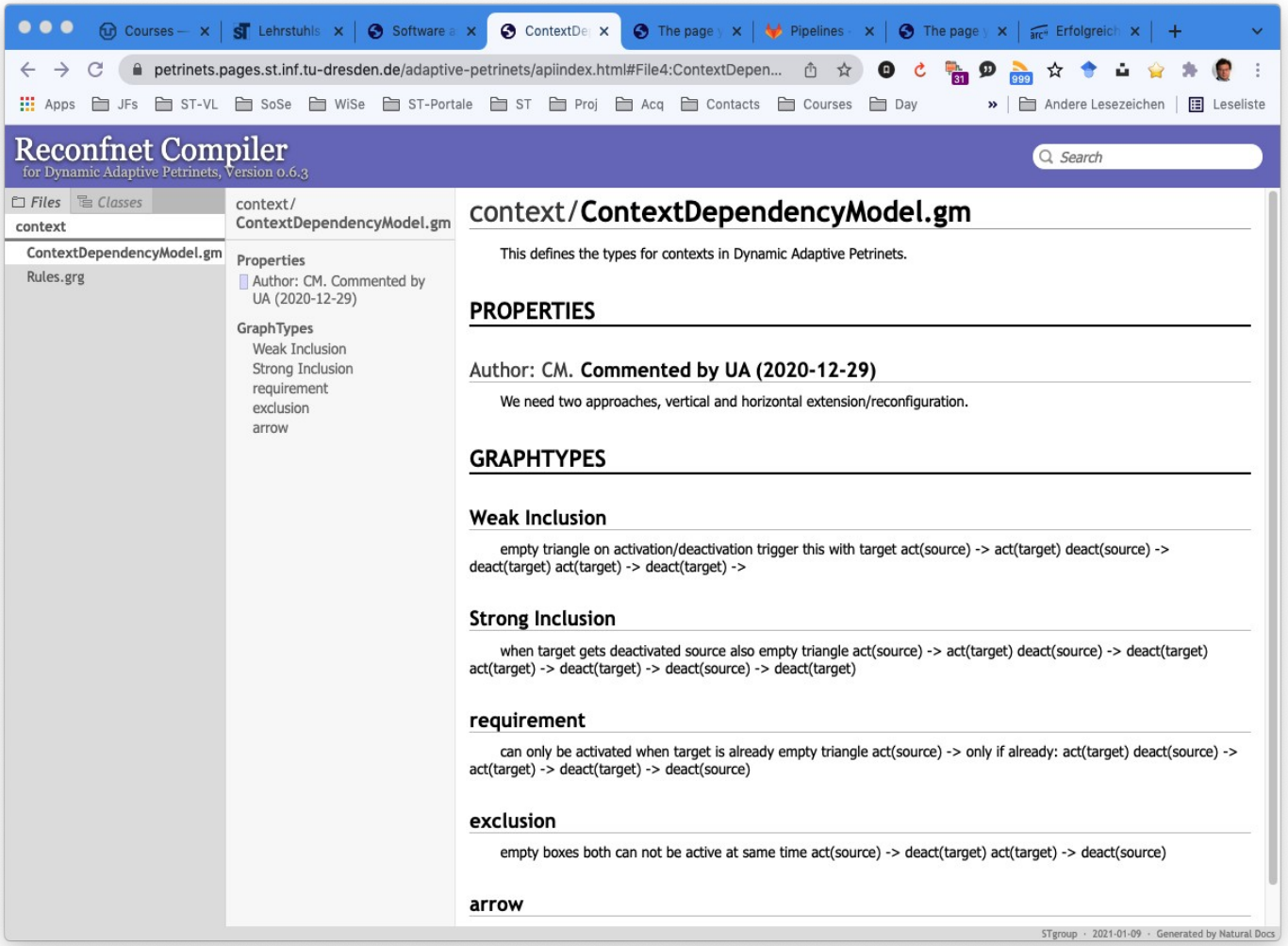
NaturalDocs Generic API Documentation Generator

- Similar to JavaDoc, but more than 20 languages
- own keywords can be defined
- Example gitlab project from which API documentation for GrGen can be generated
  - https://git-st.inf.tu-dresden.de/adaptive_petrinets/reconfnet/-/tree/master/doc



Example NaturalDocs API generated for GrGen

- GrGen.net is a generator for graph rewrite specifications (see Part IV)
- There is no specific API doc generator for GrGen, but NaturalDocs can be tailored to it



The End

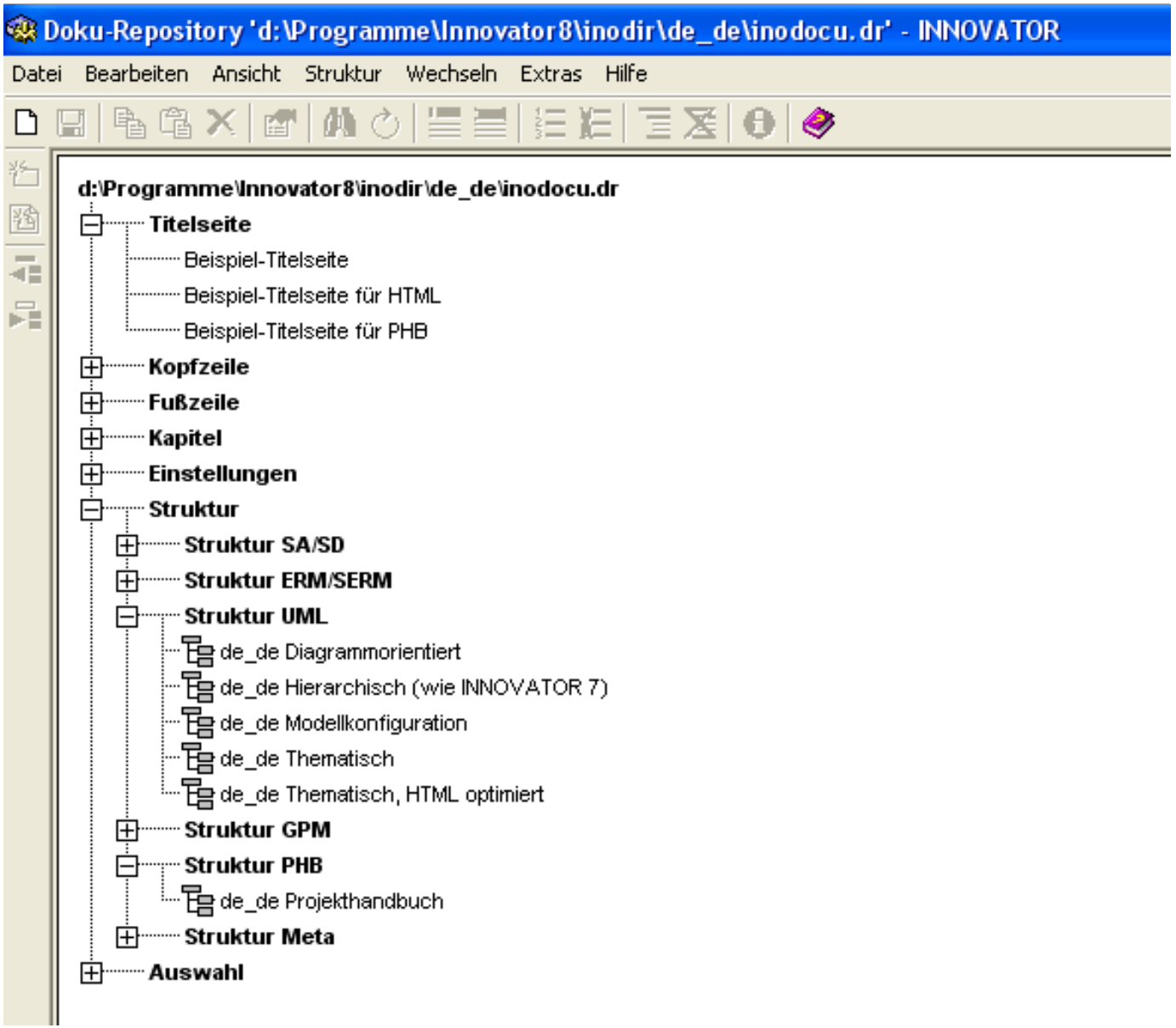
- Why is generation of documentation similar to code generation?
- Explain why a higher-order RAG is useful for documentation generation
- Which role does a pattern-matching language such as Xcerpt play in documentation generation?
- Why is the generation of documentation part of a macromodel?
- Why is a documentation a *derived model?*
- What happens if text from the API documentation flows back into the code as comments?

A.1 Other Template Expanders for Documentation Generation

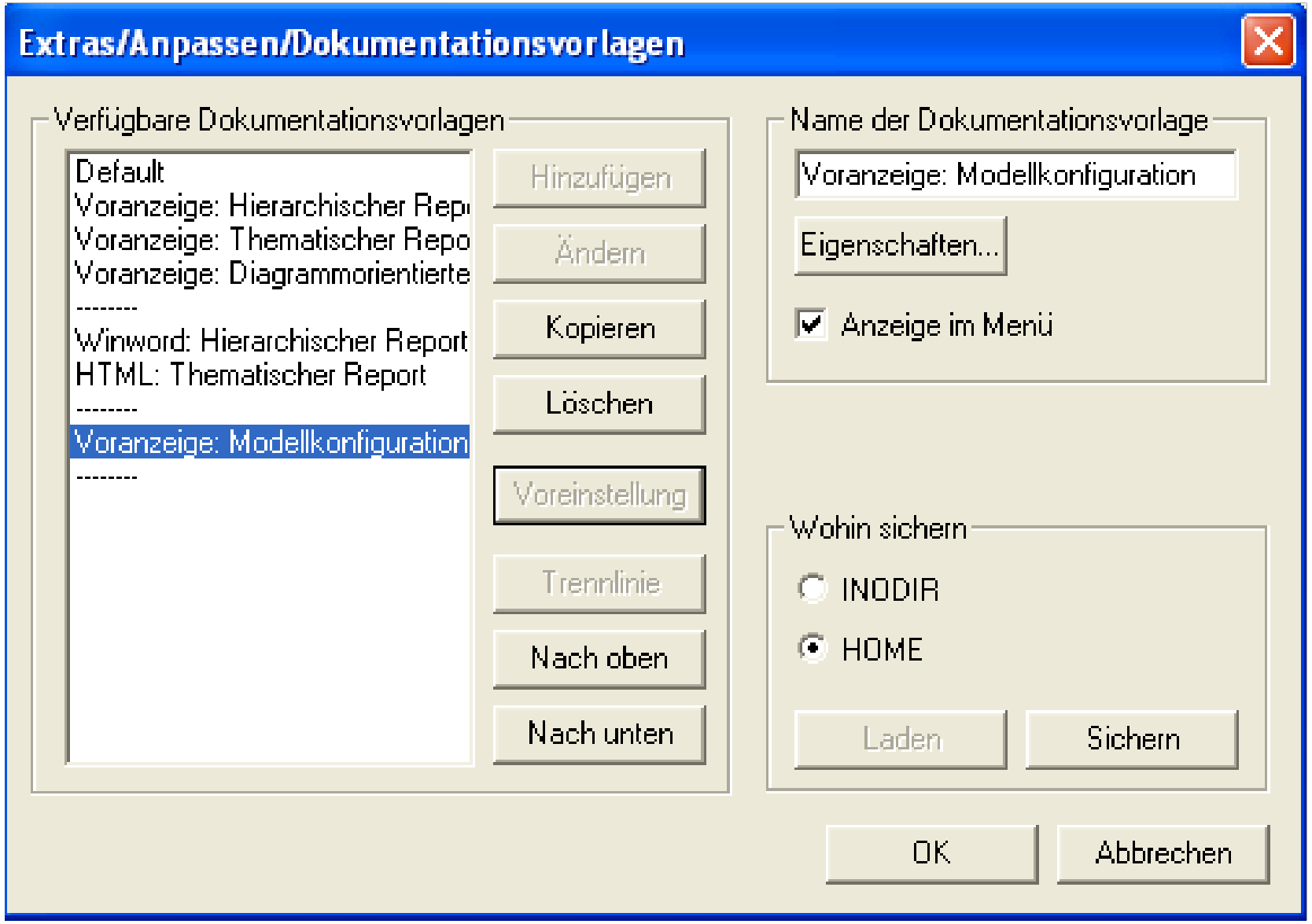
Documentation Tools of MID Innovator

- Innovator provides documentation templates, into which diagrams, models, code can be embedded
- Several formats:
  - pdf
  - Word
  - ASCII
  - XML

Ex.: Innovator Documentation Template (Dokumentationsvorlage)



Ex.: Innovator Documentation Template (Dokumentationsvorlage): Adaptation



Innovator - Generated Example Word Document

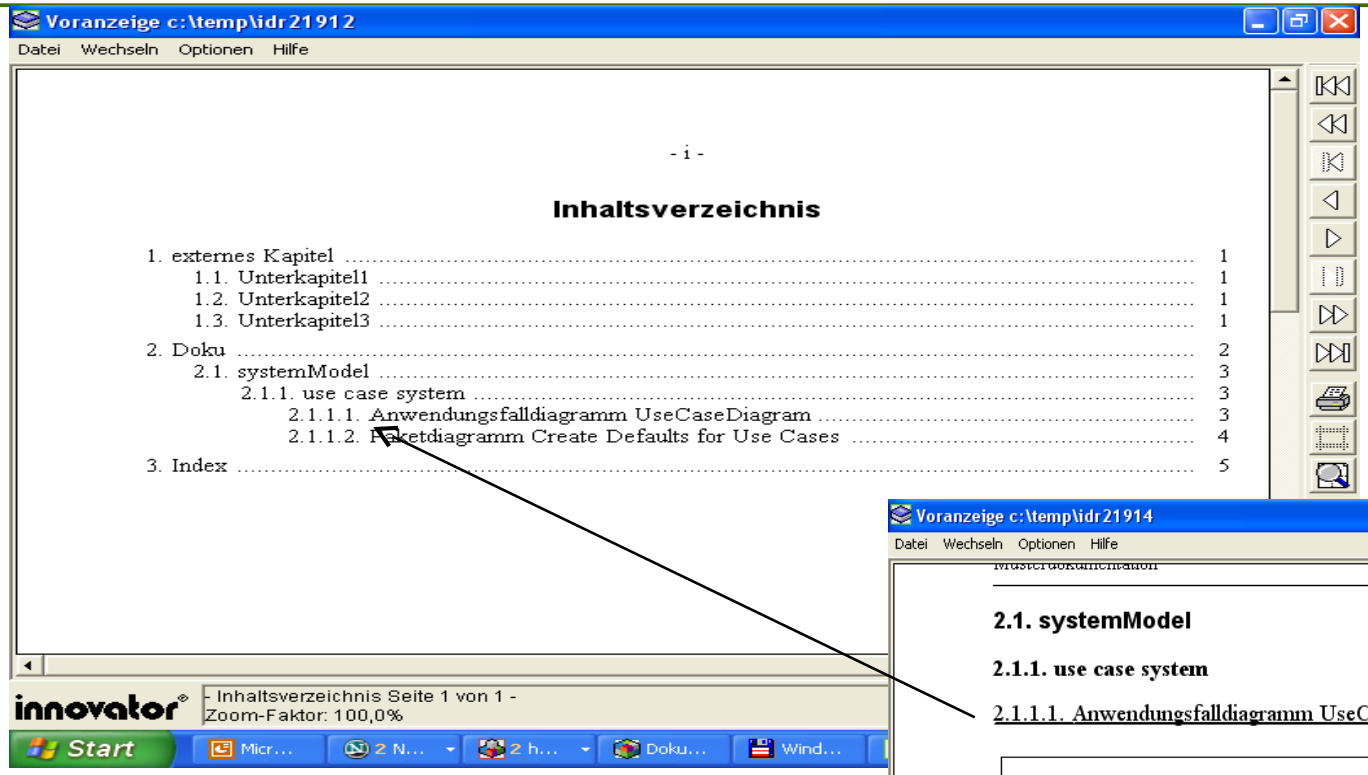
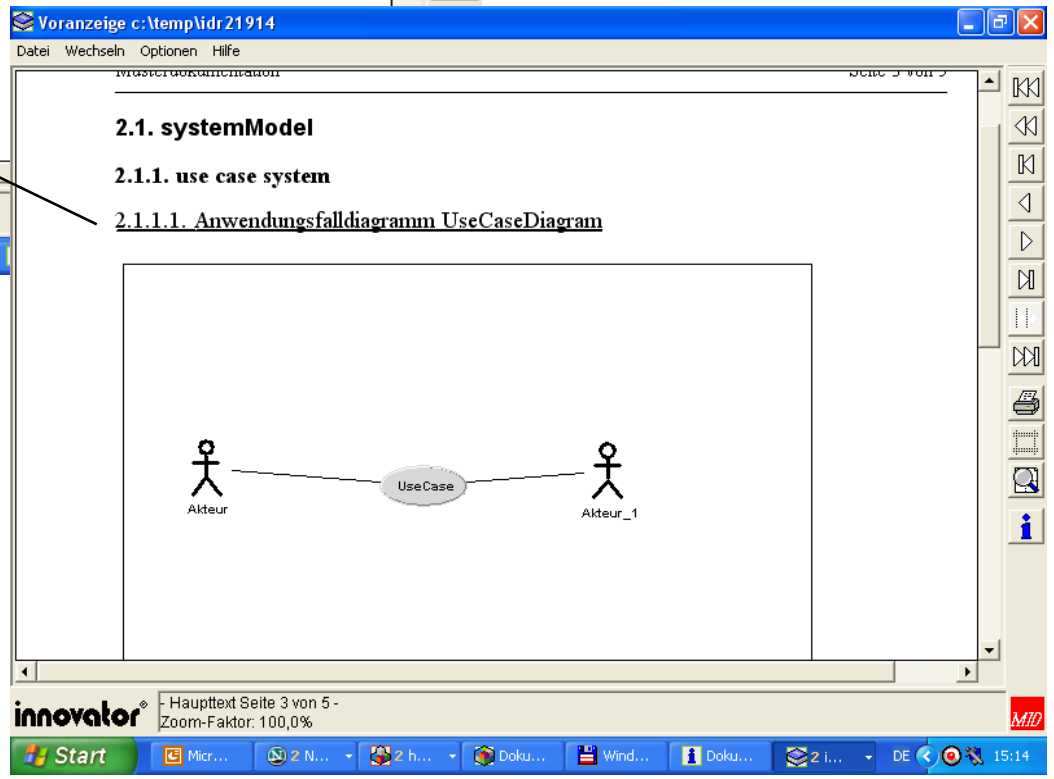


Table of Contents



Integration of a Use Case Diagram (section 2.1.1.1.)

Index is generated