AARHUS UNIVERSITET

Software Architecture in Practice

Architecture Reconstruction

Literature

Main

- [van Deursen et al., 2004]
  - van Deursen, A., Hofmeister, C., Koschke, R., Moonen, L., Riva, C. (2004) Symphony: View-Driven Software Architecture Reconstruction. In *Proceedings of the Fourth Working IEEE/IFIP Conference on Software Architecture (WICSA'04), pp 122-132*
- [Gorton and Zhu, 2005]
  - Gorton, I. and Zhu, L. (2005) Tool Support for Just-in-Time Architecture Reconstruction and Evaluation: An Experience Report. In *Proceedings of ICSE'05, pp 514-523*

Background

- [Bass et al., 2003], Chapter 10
- [Koschke, 2005a]
  - Koschke, R. (2005). What architects should know about reverse engineering and reengineering. WICSA Keynote, accessed 2008-05-07. http://www.informatik.uni-bremen.de/%7Ekoschke/koschke-keynote.pdf

Overview

Definition

Motivation

The architecture reconstruction process

Architecture reconstruction tool examples

Do you have architecture documentation of all systems in your organization?

Is it a problem?

Software Architecture Reconstruction

The process of obtaining a documented architecture for an existing system

- Architectural requirements
- Architectural views
- Architectural decisions
- …

Essentially a reverse engineering process

- Extract->abstract->present
  - Data gathering
  - Knowledge inference
  - Information presentation
- Hard for software architectures
  - Potentially a big gap between implementation and architecture
  - Active research area

Why?

Many software engineering tasks need architectural information on existing systems

- Architectural evaluation
- Refactoring
- Migration to product lines
- Application integration
- …

Architecture documentation is not always updated or available

- Architecture-as-designed <-> architecture-as-implemented
- Or outdated, incorrect, inappropriate, …

Process: “Symphony”

We will look at the “Symphony” process

- Created ao by Nokia Research

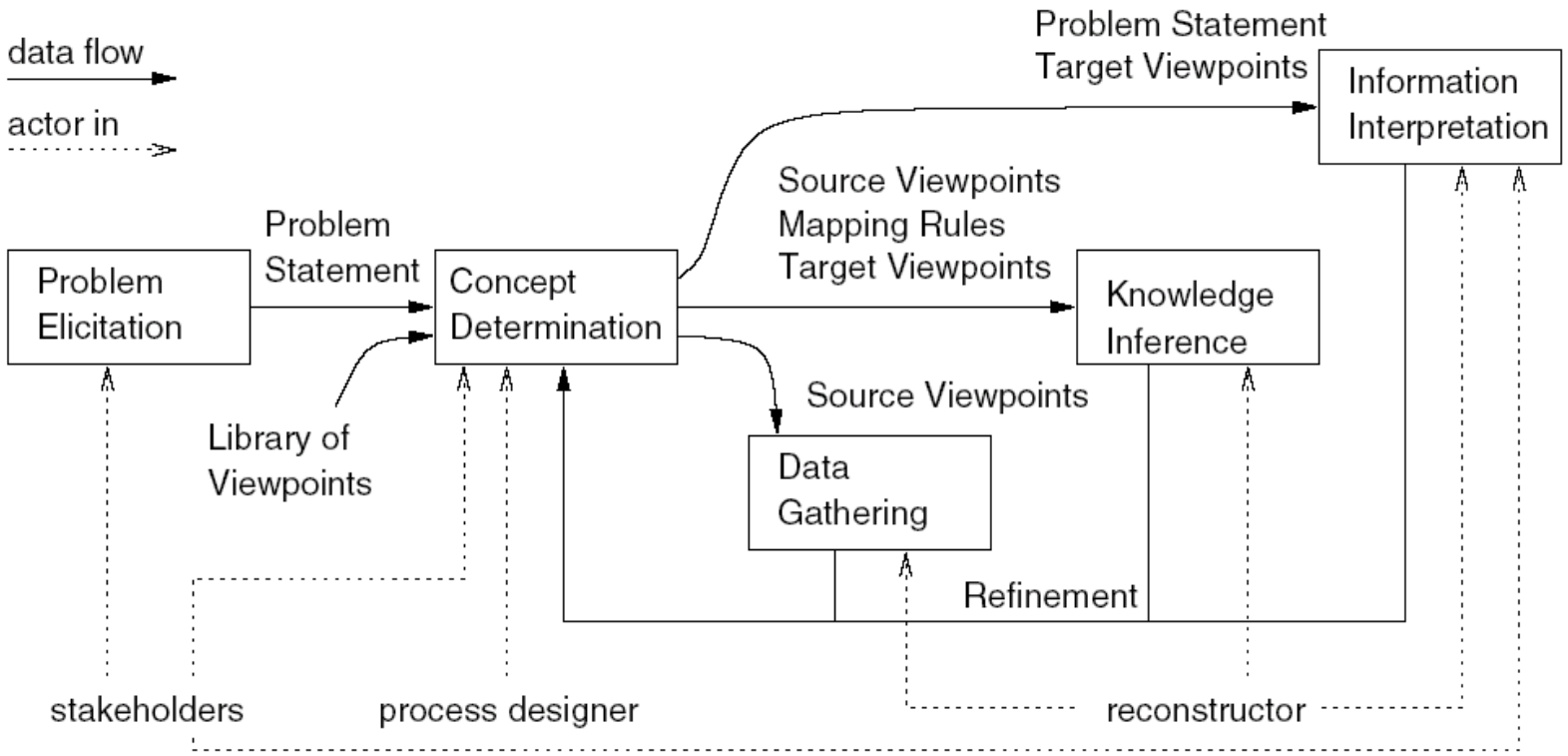
Concepts

- Views and viewpoints as in IEEE 1471
- Source view
  - View that can be extracted from artifacts of a system
  - Not all source views are architectural views
    - E.g., abstract syntax tree
- Target view
  - View that describes architecture-as-implemented
- Hypothetical view
  - Architecture-as-designed
  - Documentation
  - Presentations
  - …

Symphony Stages

Reconstruction design

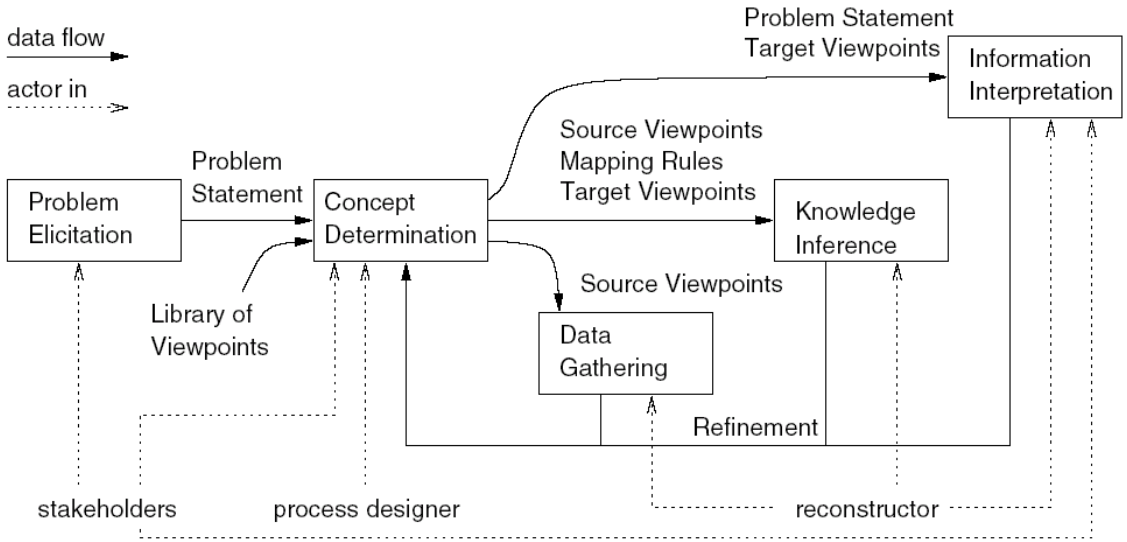
Reconstruction execution



Reconstruction design

Problem elicitation
- "Business case" for reconstruction
- What is the problem?

Concept determination
- What architectural information is needed to solve the problem?
- Which viewpoints are relevant?

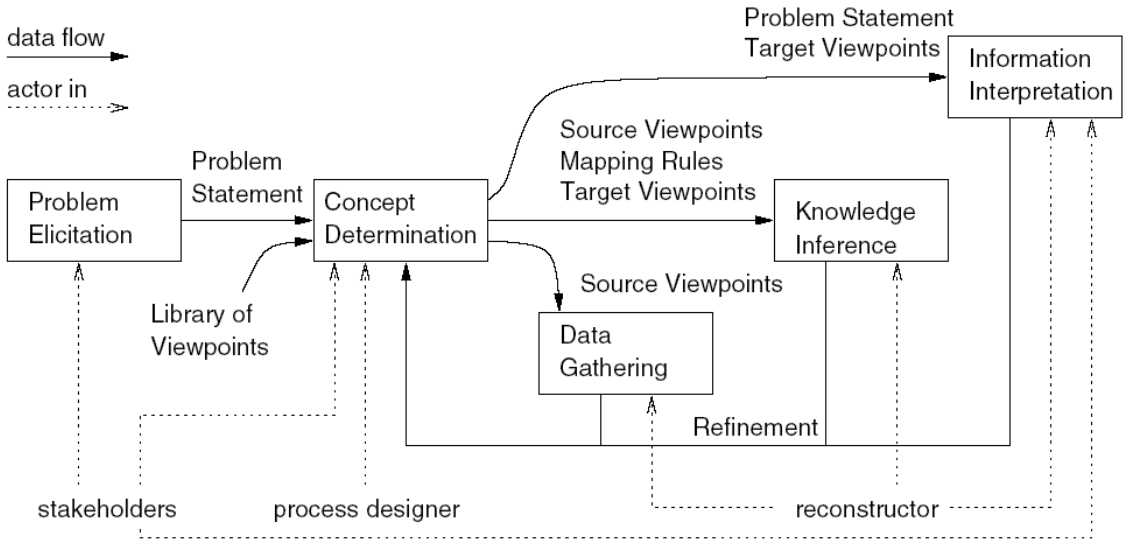


Reconstruction execution

Data gathering

Knowledge inference

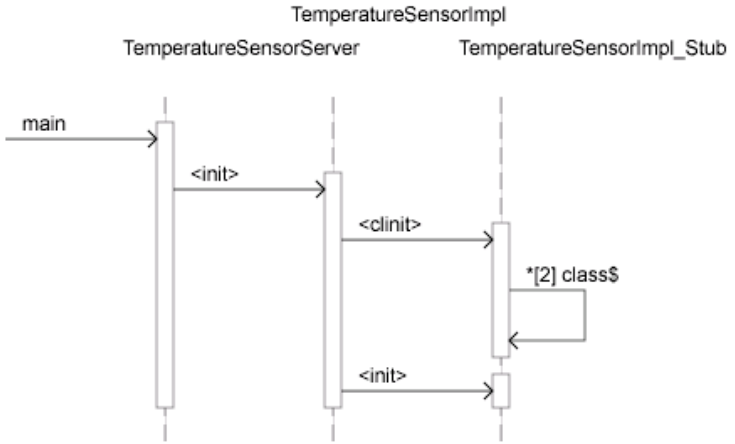
Information interpretation



Data gathering

Sources
- Running system
- Build files
- (Unit) tests
- Configuration files
- Source code
- Data(base)
- …

Techniques
- Static
  - Source-code-based
    - Manual inspection
    - Lexical analysis
    - Syntactic analysis
    - Fuzzy parsing
    - Island grammars
    - Semantic analyses
- Dynamic
  - Trace collection
    - Profiling
    - Debugging
    - Code instrumentation, e.g., using aspects
    - Special runtime environment



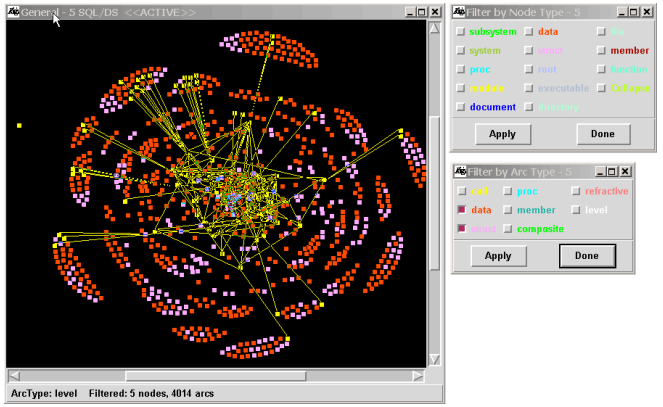
Inference and Interpretation

Knowledge inference

- Going from source to target view…
- Techniques
  - Manual
    - E.g., Rigi [Storey et al., 1996]
  - Semi-automatic
    - E.g, SQL queries for defining grouping rules (Dali)
  - Automatic

Information Interpretation

- E.g., visualizing using UML



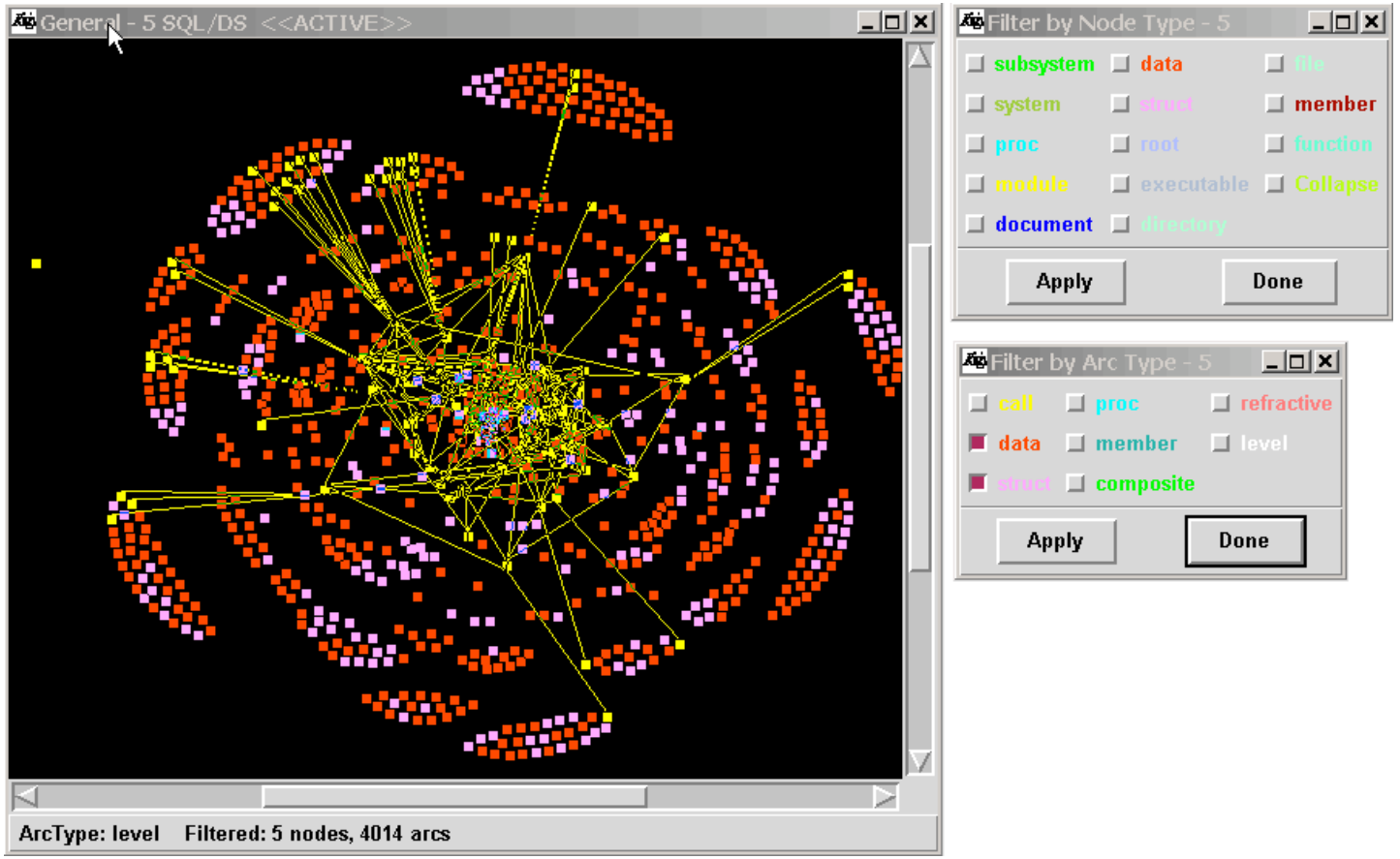
Rigi

Components of the system are nodes, relationships are arcs

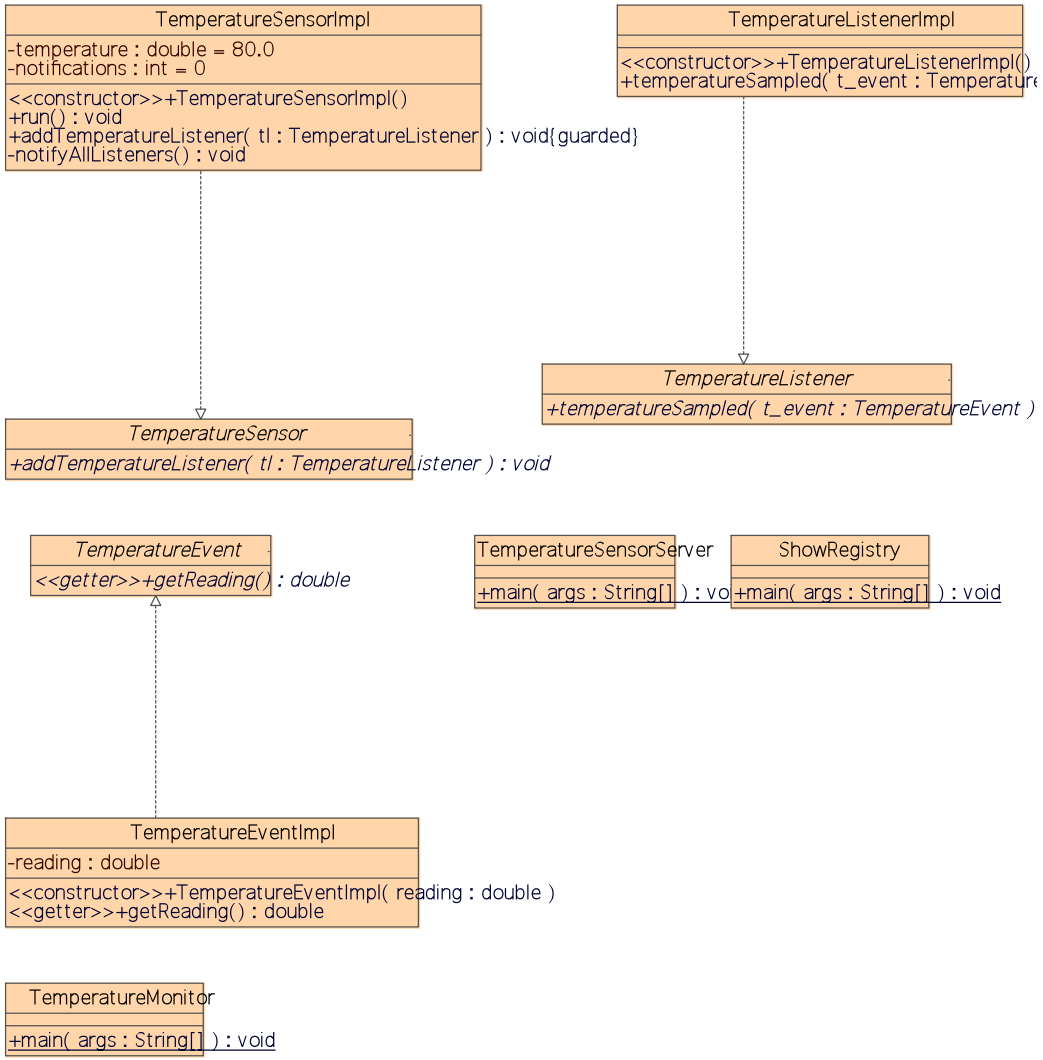
- Lead to graphs
- E.g., call graph

Example

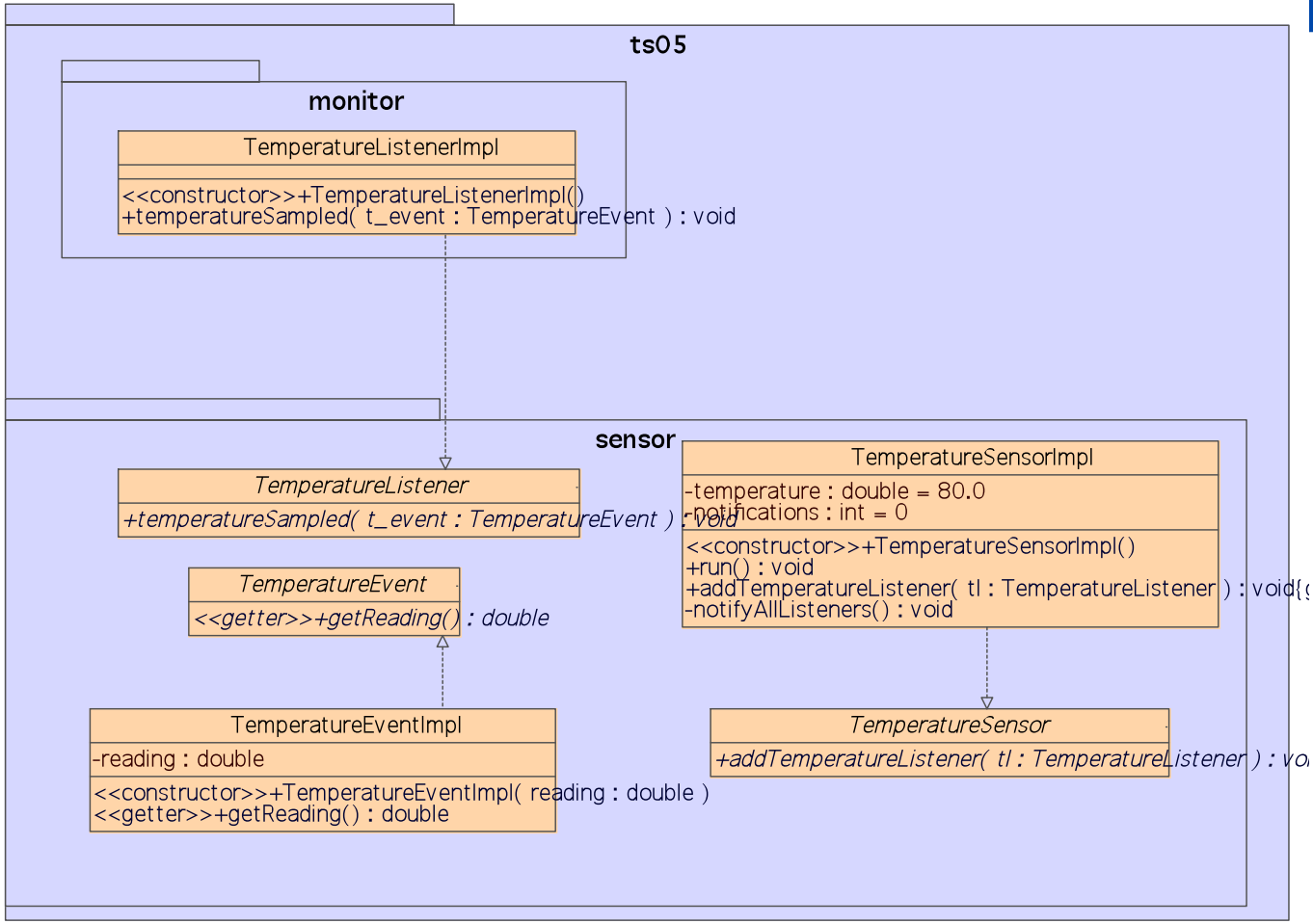
- IBM's SQL/DS system



MagicDraw (1): Module View



MagicDraw (2): Module View



Spot a problem…

MagicDraw(3): Another Problem

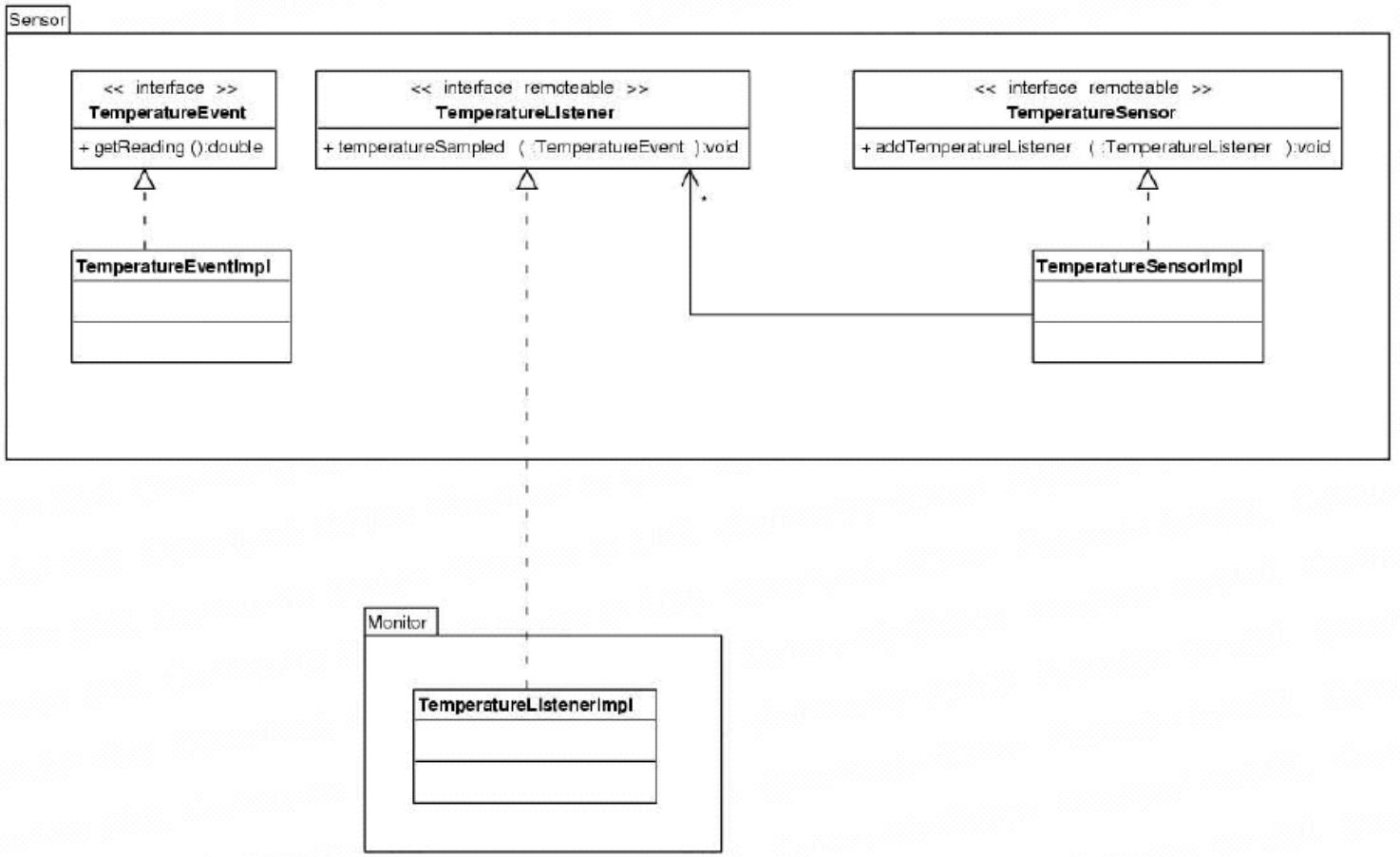

```
Parsing failed (C:\marius\Teaching\SAiP\work-in-progress\src
  \case_1\src\ts05\sensor\TemperatureSensor.java)
  Encountered "}" at line 35, column 1.

Was expecting one of:
   <EOF>
   "abstract" ...
   "class" ...
   "final" ...
   "interface" ...
   "private" ...
   "protected" ...
   "public" ...
   "static" ...
   "strictfp" ...
   "enum" ...
   "@" ...
   ";" ...
```

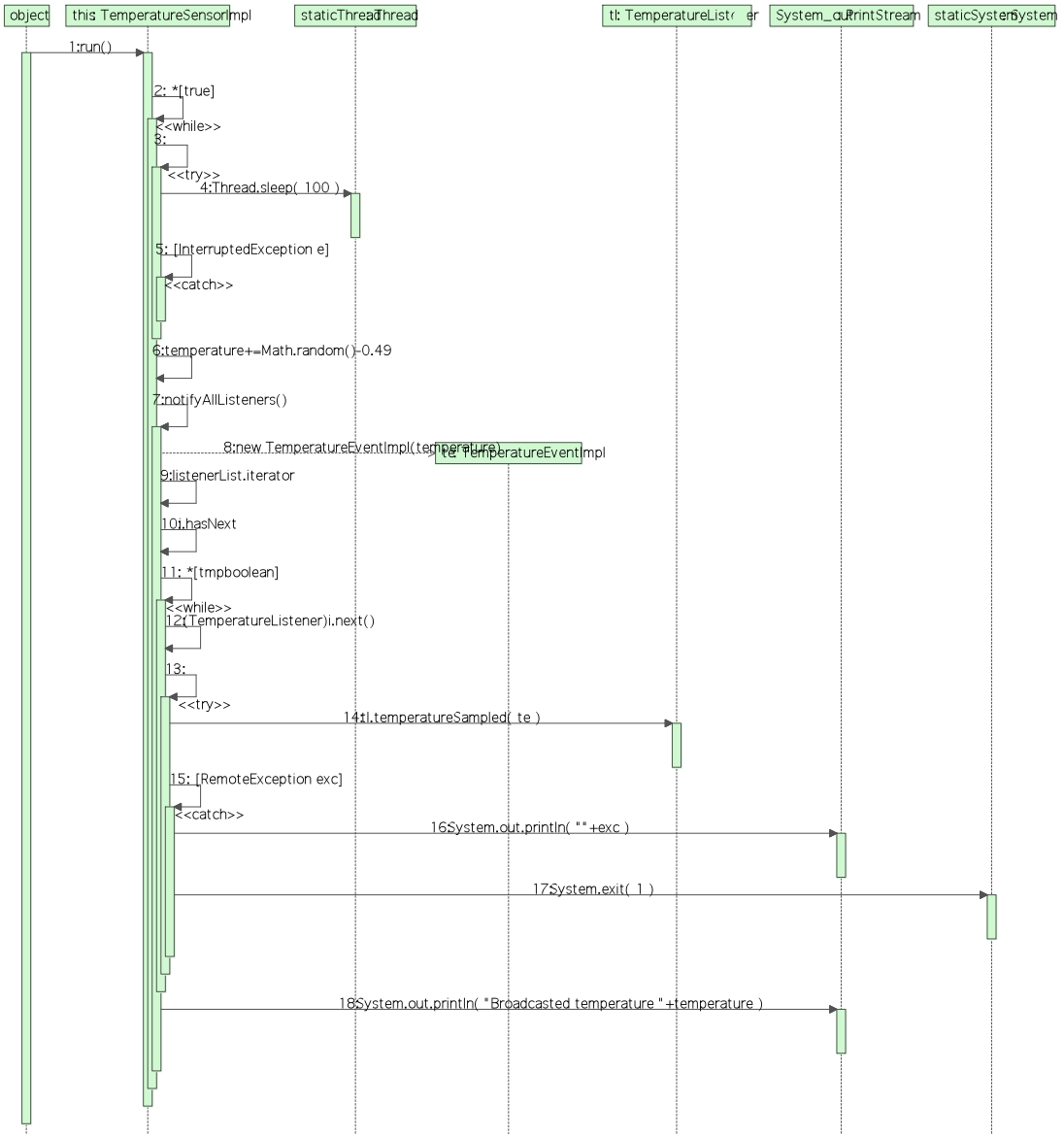
Other techniques than strict parsing

- Lexical analysis
- Fuzzy parsing
- Island grammars

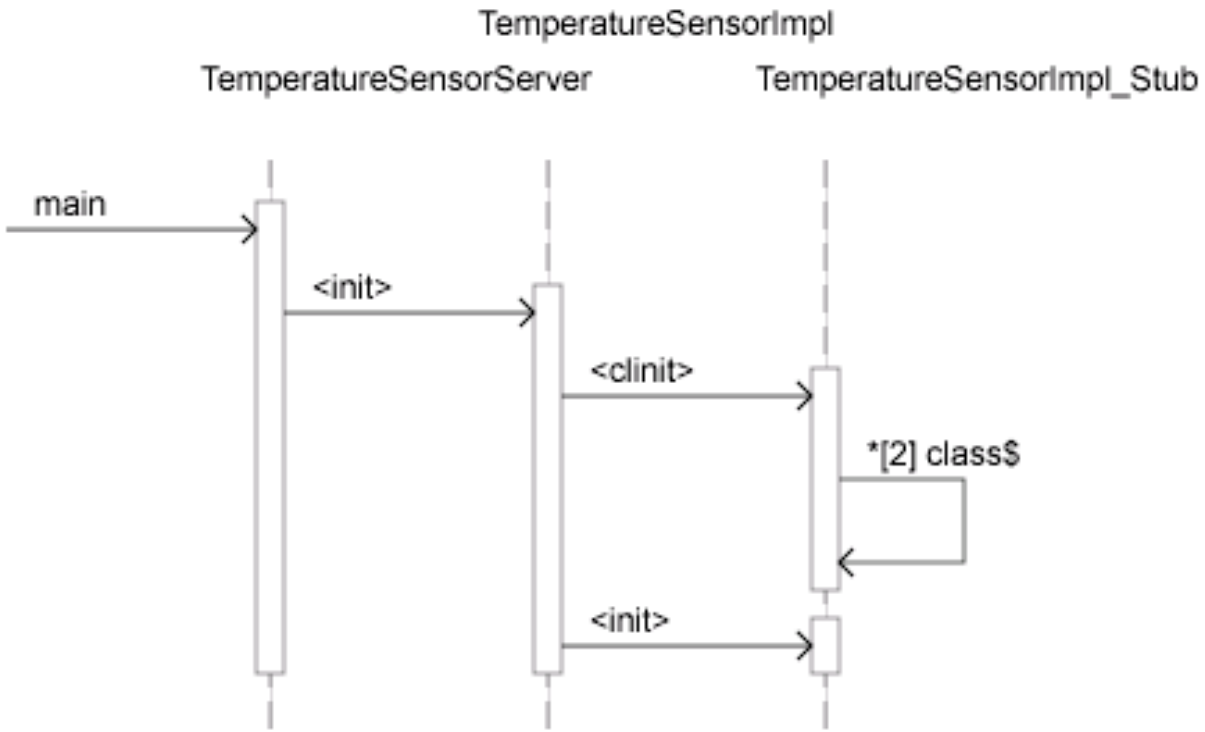
Module View: Example Manual



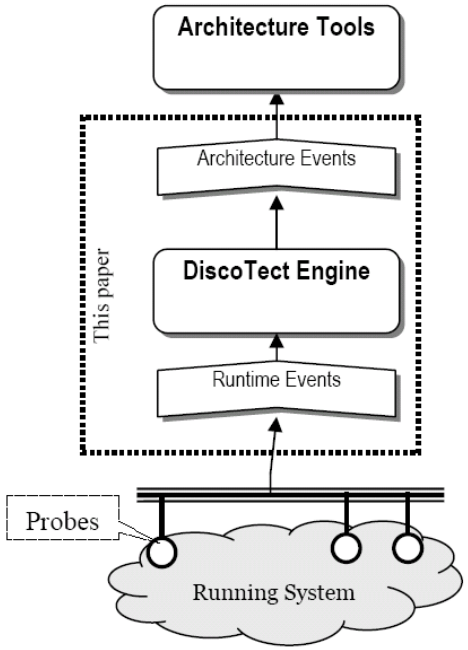
MagicDraw (4): C&C View



JSeq: C&C View


TemperatureSensorImpl
TemperatureSensorServer
TemperatureSensorImpl_Stub
main
<init>
<clinit>
*[2] class$
<init>

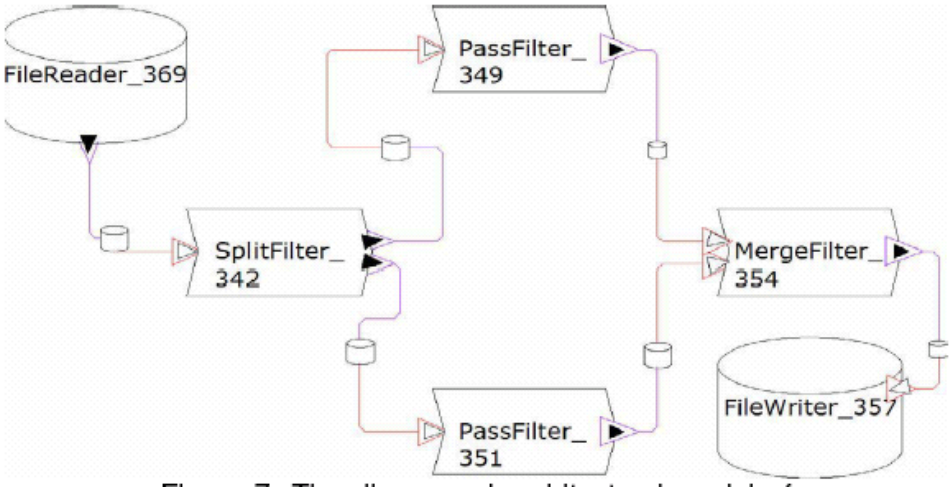
DiscoTect: C&C View



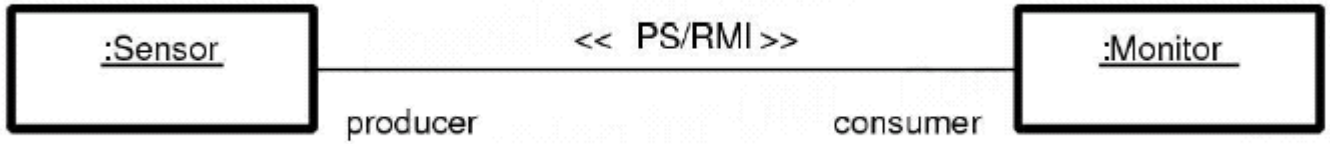
1. Call(method="v1.RegSys.main(java.lang.String[])", requestor=null, provider=null)
2. Init(constructor="v1.SplitFilter", creator=null, instance="v1.SplitFilter(name=", id=342)")
3. Init("v1.PassFilter", null, "v1.PassFilter(name=", id=349)")
4. Init("v1.PassFilter", null, "v1.PassFilter(name=", id=351)")
5. Init("v1.MergeFilter", null, "v1.MergeFilter(name=", id=354)")
6. Init("java.io.FileReader", "v1.SplitFilter(id=342)", "java.io.FileReader(id=369)")
7. Init("java.io.BufferedReader", "v1.SplitFilter(id=342)", "java.io.BufferedReader(id=418)")
8. Init("java.io.FileWriter", "v1.MergeFilter(id=354)", "java.io.FileWriter(id=357)")
9. Modify(name="java.io.Reader.lock", value="java.io.FileReader(id=369)")
10. Call("java.io.BufferedReader.readLine()", "v1.SplitFilter(id=342)", "java.io.BufferedReader(id=418)")

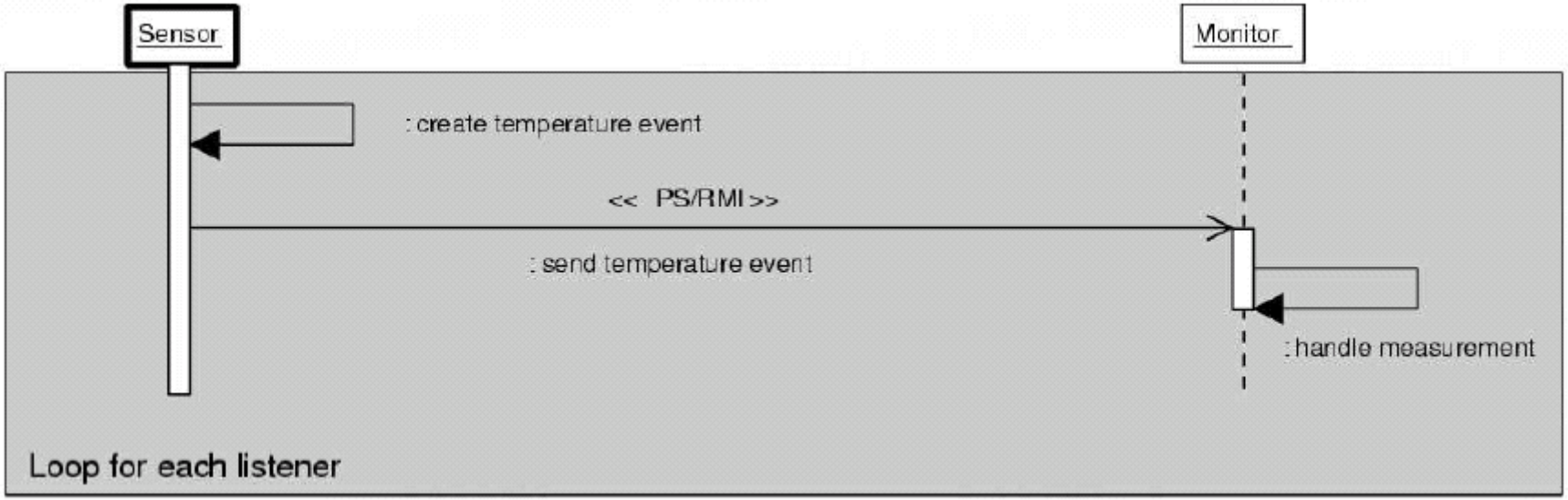
Component Creation

File Input



C&C View: Example Manual





State of the Art

http://www.informatik.uni-bremen.de/%7Ekoschke/koschke-keynote.pdf

Cat.	Style	Content	#Publ.
M	decomposition	part-of	43
	feature location	implements	16
	design patterns	element participates-in pattern	12
	class diagrams	association, aggregation	10
	conformance	conforms-to, deviates-from	7
	interfaces	requires, provides	3
	use cases	implemented-by	2
	configuration	varies-with	2
	class hierarchies	inherits, attribute-of, method-of	2
CC	object interaction	interacts-with	12
	process interaction	interacts-with	10
	component interaction	interacts-with	3
	conceptual viewpoint	implemented-by	3
	object traces	applied operations	2
A	responsibilty	responsible-for	1
	build process	generated-by	1
	files	described-in, stored-in	1

Discussion

Allocation view?

No commercial tool covering all aspects available

- Tailor to project-specific needs?