Model-based Feedback for Software Performance Improvement

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Roadmap

» Problem statement and motivation
» Related works
» A vision of the approach
» Future works and open issues

Catia Trubiani, "Model-Driven Quality Prediction" Dagstuhl Seminar, nov 29 - dec 2, 2009
**Problem statement and motivation**

What to change to improve the software design?

![Diagram showing architectural model and performance analysis](image)

Catia Trubiani, "Model-Driven Quality Prediction" Dagstuhl Seminar, Nov 29 - Dec 2, 2009

**Software Performance Analysis Process**

1. Model2Model Transformation
2. Performance Model
3. Model Solution
4. Performance Indices
5. Results Interpretation and Feedback Generation
6. Performance Antipatterns

- Performance Indices complexity
  - Numbers to be interpreted
  - Different levels of granularity
  - Cross-checking of software system characteristics

Catia Trubiani, "Model-Driven Quality Prediction" Dagstuhl Seminar, Nov 29 - Dec 2, 2009
**Performance Antipatterns**


  - Look at negative features of a software system:
    - The definition includes common mistakes (i.e. "bad practice") in software development as well as their solutions

<table>
<thead>
<tr>
<th>Antipattern</th>
<th>Problem</th>
<th>Solution</th>
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- What to avoid and how to solve (performance) problems!

Gatta Trubiani, "Model-Driven Quality Prediction" Dagstuhl Seminar, nov 29 - dec 2, 2009

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**Related works**

  - Informal interpretation matrices from the analysis of Layered Queueing Networks (LQNs)

  - Performance antipattern detection (PAD) tool for Enterprise Java Bean (EJB) applications

  - Analysis of LQNs performance model for bottlenecks and long paths

  - Exploring design space with meta-heuristics techniques

Gatta Trubiani, "Model-Driven Quality Prediction" Dagstuhl Seminar, nov 29 - dec 2, 2009
A vision of the approach: a Framework

» Performance Antipatterns in action 😊!!!

(1) Specifying Antipatterns

(2) Detecting Antipatterns

(3) Solving Antipatterns

Framework activities (1/6)

» Specifying antipatterns

- Select the minimum amount of the system model properties that are able to express the antipatterns specification
Framework activities (2/6)

Embedding antipatterns

- Translate the system model properties into concrete modeling notations (e.g. UML + Marte, Aemilia, etc.)

Antipatterns neutral notation

UML + Marte

correspondences between
Antipatterns neutral notation
and UML+Marte

Gata Trubiani, "Model-Driven Quality Prediction" Dagstuhl Seminar, nov 29 - dec 2, 2009

Framework activities (3/6)

Detecting antipatterns

- Look for performance antipatterns properties in the system model in order to locate performance issues

Gata Trubiani, "Model-Driven Quality Prediction" Dagstuhl Seminar, nov 29 - dec 2, 2009
**Framework activities (4/6)**

**Rating antipatterns**

- Estimate how much a Performance Antipattern $PA_i$ is important for the Violated Requirement $R_j$

![Diagram showing the rating of antipatterns](image)

**Framework activities (5/6)**

**Combining antipatterns**

- Estimate how much a simultaneous set of antipatterns solutions (i.e. a "move") is important for performance improvements

![Diagram showing the combining of antipatterns](image)
**Framework activities (6/6)**

- **Solving antipatterns**
  - Change the system model applying performance antipatterns solutions thus to obtain performance improvements

**Experimentation (1/2)**

- **XML-based Approach**

V. Cortellessa, A. Di Marco, C. Trubiani “Performance Antipatterns as Logical Predicates”, technical report.
**Experimentation (2/2)**

Model-driven Approach

V. Cortellizzi, A. Di Marco, R. Eramo, A. Pierantonio, C. Trubiani, "Approaching the model-driven generation of feedback to remove software performance flaws", EUROMICRO 2009

- High-order transformations
- Validate the scope of the whole approach across languages, to assess the independence of any concrete notation.
- Real case studies to analyse the usability and the scalability of the approach.

Crista Trubiani, "Model-Driven Quality Prediction" Dagstuhl Seminar, nov 29 - dec 2, 2009
Open issues

» Requirements issues
  - Functional requirement
    > Legacy components cannot be split or re-deployed
  - Non-Functional requirement
    > Budget limitations

» Coherency issues
  - Incoherences among antipattern solutions

» Maintenance issues
  - What happens if the design and the architectural changes are performed at run-time (e.g. pervasive systems)? How do the performance antipatterns change across the run-time reconfigurations of the system?

» Further issues
  - Can an antipattern solution introduce another antipattern? How do the workload and the operational profile affect the antipatterns identified?

Questions?

Catsi Trubiani, "Model-Driven Quality Prediction" Dagstuhl Seminar, Nov 29 - Dec 2, 2009