Systematic Refinement of Performance Prediction Models

Lucia Kapova
Software Design and Quality Group
Motivation

Abstract Models

Implementation
Motivation

Abstract Models

Implementation

JBoss, Messaging, Transactional delivery ...

Prediction

Low-level details!

Measurements
Motivation

Lucia Kapova: Systematic Refinement of Performance Prediction Models

Abstract Models

Implementation

JBoss, Messaging, Transactional delivery ...

Completion

Prediction

Measurements
The Completions Library

Lucia Kapova: Systematic Refinement of Performance Prediction Models
The Completion

Lucia Kapova: Systematic Refinement of Performance Prediction Models
The Annotation: Feature Model

Messaging Connector

Legend

- Exclusive OR
- Mandatory Feature
- Optional Feature

- Point-to-Point Channel
- Publish-Subscribe Channel
- Durable Subscriber
- Transactional Client
- Guaranteed Delivery
- Transaction Size
- Competing Consumers
- Selective Consumer
- Pool Size

[ Holger: A Pattern-Based Performance Completion for Message-Oriented Middleware, 2007 ]
The Annotation: Feature Config

Messaging Connector

Legend

- Exclusive OR
- Mandatory Feature
- Optional Feature

- Point-to-Point Channel
- Publish-Subscribe Channel
- Durable Subscriber
- Transactional Client
- Guaranteed Delivery
- Transaction Size
- Competing Consumers
- Pool Size
- Selective Consumer
Architecture Refinement

Generated Transformation

[Messaging Completion]

[Kapova, L.: Automated feature model-based generation of refinement transformations, 2009]
Motivating Example

- Barrier
- ThreadPool
- Compression
- Replication
- Locking
- MOM
- Encryption
- Pipe & Filter
Motivating Example

- Barrier
- ThreadPool
- MOM
- Encryption
- Compression
- Replication
- Pipe & Filter
- Locking
Completion Order

Source

C1 → C2

Target

C1 → C2

Confluence?
Conflict Definition

- The completion chain is conflicting when at least one pair of completions is in:
  - **structural conflict**
  - *Example: Replication and LoadBalancer*

![Diagram showing conflict]

Lucia Kapova: Systematic Refinement of Performance Prediction Models
Solution steps

1. Transformation Pipelining

2. Rule-based Transformation Merge

3. Quality-aware Conflict Resolution
   - Heuristics based on Quality Metrics Optimization
Conflict Reduction
Roles and Responsibilities Separation

Metamodel Clustering
→ Transformation Pipelining

Lucia Kapova: Systematic Refinement of Performance Prediction Models
Conflict Reduction
Conflicting Model Elements Identification

Impacted Element Set
→ Rule-based Transformation Merge → Higher-Order Problem
## Completions for Concurrent Software Systems

<table>
<thead>
<tr>
<th>Role</th>
<th>Event-based communication</th>
<th>Synchronisation</th>
<th>Concurrency</th>
<th>Message-oriented communication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Component Developer</td>
<td></td>
<td>Scoped Locking</td>
<td>Thread-specific Storage</td>
<td>Messaging Endpoints</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Strategized Locking</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Thread-safe Interface</td>
<td>Thread-specific Storage</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Double-checked Locking Optimalisation</td>
<td>Monitor Object</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rendezvous/Barrier</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Software Architect</td>
<td>Asynchronous Completion Token</td>
<td></td>
<td>Replication</td>
<td>Message Channel</td>
</tr>
<tr>
<td>System Deployer</td>
<td>Reactor</td>
<td></td>
<td>Active Object</td>
<td>Message Routing</td>
</tr>
<tr>
<td></td>
<td>Proactor</td>
<td></td>
<td>Half-Sync/Half-Async</td>
<td>Message Endpoints</td>
</tr>
<tr>
<td></td>
<td>Acceptor-Connector</td>
<td></td>
<td>Leaders Followers</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Thread Pool</td>
<td></td>
</tr>
</tbody>
</table>
Experiment

Roundtrip Response Time Interval: <496ms, 1574ms>
Conclusion and Future Work

Evaluation
- Implementation Prototyp: http://sdqweb.ipd.kit.edu/wiki/Chilies
- Case Study (ThreadPool, MOM, Replication, Pub-Sub Configurations)

Contributions
- Systematic Refinement Conflict Reduction
- Structured Completion Library
- Automated Conflict Resolution for Structural Conflicts

Future Work
- Specify Heuristics for Resolution of Quality Conflicts
- Analyze and Validate Quality Metrics for Optimization
- Extend Completion Library
Thanks!
kapova@ipd.uka.de
http://sdq.ipd.uka.de