Taming Aspects with Managed Data

Theologos A. Zacharopoulos

theol.zacharopoulos@gmail.com

 $March\ 14,\ 2016,\ 14\ pages$

Supervisor: Tijs van der Storm

Host organisation: Centrum Wiskunde & Informatica, http://www.cwi.nl

Contents

Abstract 3						
1	1.1	roduction Initial Study	4			
	1.2	Problem statement	4			
		1.2.1 Research Questions	4			
		1.2.2 Solutions Outline	4			
		1.2.3 Research Method	4			
	1.3	Contributions	4			
	1.4	Related Work	4			
	1.5	Document Outline	4			
2	Bac	ekground	5			
	2.1	Cross Cutting Concerns	5			
	2.2	Aspect Oriented Programming	5			
		2.2.1 Aspect Oriented Programming Showcases	5			
		2.2.2 Design Patterns in Aspect Oriented Programming	5			
		2.2.3 Aspect Oriented Programming Evaluation	5			
		2.2.4 Evolvability	5			
	2.3	Managed Data	5			
	2.0	2.3.1 Schemas	5			
		2.3.2 Data Managers	5			
	2.4	Java Reflection and Proxies	5			
	2.4	2.4.1 Reflection	5			
		2.4.2 Reflection and MetaObject Protocol	5			
		2.4.3 Dynamic Proxies	5			
	2.5	JHotDraw And AJHotDraw	5 5			
	2.5		5 5			
		2.5.1 Refactoring of Crosscutting Concerns	-			
		2.5.2 The Undo Concern of JHotDraw	5			
		2.5.3 The Persistence Concern of JHotDraw	5			
3	Imp	plementation	6			
	3.1	Managed Data	6			
		3.1.1 Schema	6			
		3.1.2 Data Managers	6			
	3.2	Bootstrapping	6			
		3.2.1 Cutting the umbilical cord	6			
	3.3	Self-describing schema (SchemaSchema)	6			
	3.4	Schema Loading	6			
		3.4.1 Forward	6			
		3.4.2 Wire the Cross-References	6			
	3.5	Typing	6			
	-	3.5.1 Primitives	6			
		3.5.2 Collections	6			

3.6.1 Methods ordering 3.6.2 Hash-code of Managed Objects 3.6.3 Default methods of Managed Objects 3.6.4 Collections of Managed Objects 3.6.5 Transparent equivalence 4 Evaluation 4.0.1 Research Questions and Answers 4.0.2 Evidence 4.0.3 Results 4.0.4 Claims 5 Conclusion 6 Further Work A How to Use the Framework B Example Application B.1 Schemas definition B.1.1 Point Schema B.1.2 Line Schema B.2 Data managers definition B.2.1 Basic Data Manager B.2.2 Lockable Data Manager B.2.3 Observable Data Manager B.2.3 Observable Data Manager B.3.3 Tame Aspects	
3.6.3 Default methods of Managed Objects 3.6.4 Collections of Managed Objects 3.6.5 Transparent equivalence 4 Evaluation 4.0.1 Research Questions and Answers 4.0.2 Evidence 4.0.3 Results 4.0.4 Claims 5 Conclusion 6 Further Work A How to Use the Framework B Example Application B.1 Schemas definition B.1.1 Point Schema B.1.2 Line Schema B.1.2 Line Schema B.2 Data managers definition B.2.1 Basic Data Manager B.2.2 Lockable Data Manager B.2.3 Observable Data Manager	
3.6.4 Collections of Managed Objects 3.6.5 Transparent equivalence 4 Evaluation 4.0.1 Research Questions and Answers 4.0.2 Evidence 4.0.3 Results 4.0.4 Claims 5 Conclusion 6 Further Work A How to Use the Framework B Example Application B.1 Schemas definition B.1.1 Point Schema B.1.2 Line Schema B.1.2 Line Schema B.2 Data managers definition B.2.1 Basic Data Manager B.2.2 Lockable Data Manager B.2.3 Observable Data Manager	
3.6.5 Transparent equivalence 4 Evaluation 4.0.1 Research Questions and Answers 4.0.2 Evidence 4.0.3 Results 4.0.4 Claims 5 Conclusion 6 Further Work A How to Use the Framework B Example Application B.1 Schemas definition B.1.1 Point Schema B.1.2 Line Schema B.1.2 Line Schema B.2.1 Basic Data Manager B.2.1 Lockable Data Manager B.2.2 Lockable Data Manager B.2.3 Observable Data Manager	
4 Evaluation 4.0.1 Research Questions and Answers 4.0.2 Evidence 4.0.3 Results 4.0.4 Claims 5 Conclusion 6 Further Work A How to Use the Framework B Example Application B.1 Schemas definition B.1.1 Point Schema B.1.2 Line Schema B.1.2 Line Schema B.2 Data managers definition B.2.1 Basic Data Manager B.2.2 Lockable Data Manager B.2.3 Observable Data Manager	
4.0.1 Research Questions and Answers 4.0.2 Evidence 4.0.3 Results 4.0.4 Claims 5 Conclusion 6 Further Work A How to Use the Framework B Example Application B.1 Schemas definition B.1.1 Point Schema B.1.2 Line Schema B.1.2 Line Schema B.2.1 Basic Data Manager B.2.1 Basic Data Manager B.2.2 Lockable Data Manager B.2.3 Observable Data Manager	
4.0.2 Evidence 4.0.3 Results 4.0.4 Claims 5 Conclusion 6 Further Work A How to Use the Framework B Example Application B.1 Schemas definition B.1.1 Point Schema B.1.2 Line Schema B.1.2 Line Schema B.2 Data managers definition B.2.1 Basic Data Manager B.2.2 Lockable Data Manager B.2.3 Observable Data Manager	
4.0.3 Results 4.0.4 Claims 5 Conclusion 6 Further Work A How to Use the Framework B Example Application B.1 Schemas definition B.1.1 Point Schema B.1.2 Line Schema B.1.2 Line Schema B.2 Data managers definition B.2.1 Basic Data Manager B.2.2 Lockable Data Manager B.2.3 Observable Data Manager	
4.0.4 Claims 5 Conclusion 6 Further Work A How to Use the Framework B Example Application B.1 Schemas definition B.1.1 Point Schema B.1.2 Line Schema B.1.2 Line Schema B.2 Data managers definition B.2.1 Basic Data Manager B.2.2 Lockable Data Manager B.2.3 Observable Data Manager	
5 Conclusion 6 Further Work A How to Use the Framework B Example Application B.1 Schemas definition B.1.1 Point Schema B.1.2 Line Schema B.1.2 Line Schema B.2 Data managers definition B.2.1 Basic Data Manager B.2.2 Lockable Data Manager B.2.3 Observable Data Manager	
6 Further Work A How to Use the Framework B Example Application B.1 Schemas definition B.1.1 Point Schema B.1.2 Line Schema B.2 Data managers definition B.2.1 Basic Data Manager B.2.2 Lockable Data Manager B.2.3 Observable Data Manager	
A How to Use the Framework B Example Application B.1 Schemas definition B.1.1 Point Schema B.1.2 Line Schema B.2 Data managers definition B.2.1 Basic Data Manager B.2.2 Lockable Data Manager B.2.3 Observable Data Manager	
B Example Application B.1 Schemas definition B.1.1 Point Schema B.1.2 Line Schema B.2 Data managers definition B.2.1 Basic Data Manager B.2.2 Lockable Data Manager B.2.3 Observable Data Manager	
B.1 Schemas definition B.1.1 Point Schema B.1.2 Line Schema B.2 Data managers definition B.2.1 Basic Data Manager B.2.2 Lockable Data Manager B.2.3 Observable Data Manager	1
B.1.1 Point Schema	1
B.1.2 Line Schema B.2 Data managers definition B.2.1 Basic Data Manager B.2.2 Lockable Data Manager B.2.3 Observable Data Manager	1
B.2 Data managers definition B.2.1 Basic Data Manager B.2.2 Lockable Data Manager B.2.3 Observable Data Manager	1
B.2.1 Basic Data Manager B.2.2 Lockable Data Manager B.2.3 Observable Data Manager	1
B.2.2 Lockable Data Manager	
B.2.3 Observable Data Manager	
and the control of th	
B.3 Tame Aspects	
B.3.1 Immutability	
B.3.2 Logging	
B.3.3 More	1
C Refactoring of JHotDraw's Undo Concern	1
Bibliography	1

Abstract

Introduction

- 1.1 Initial Study
- 1.2 Problem statement
- 1.2.1 Research Questions
- 1.2.2 Solutions Outline
- 1.2.3 Research Method
- 1.3 Contributions
- 1.4 Related Work
- 1.5 Document Outline

Background

2.1	Cross Cutting Concerns
2.2	Aspect Oriented Programming
2.2.1	Aspect Oriented Programming Showcases
2.2.2	Design Patterns in Aspect Oriented Programming
2.2.3	Aspect Oriented Programming Evaluation
2.2.4	Evolvability
2.3	Managed Data
2.3.1	Schemas
2.3.2	Data Managers
2.4	Java Reflection and Proxies
241	Reflection

2.5 JHotDraw And AJHotDraw

Dynamic Proxies

2.4.2 Reflection and MetaObject Protocol

2.5.1 Refactoring of Crosscutting Concerns

Role-based Refactoring of Crosscutting Concerns.

Evaluation

2.4.3

Uniform Proxies

2.5.2 The Undo Concern of JHotDraw

Evaluation

AspectJ Drawbacks in the Undo Solution

2.5.3 The Persistence Concern of JHotDraw

Implementation

3.6.5 Transparent equivalence

3.1	Managed Data				
3.1.1	Schema				
Schema Definition					
3.1.2	Data Managers				
Data Managers Definition					
3.2	Bootstrapping				
3.2.1	Cutting the umbilical cord				
3.3	Self-describing schema (SchemaSchema)				
3.4	Schema Loading				
3.4.1	Forward				
3.4.2	Wire the Cross-References				
3.5	Typing				
3.5.1	Primitives				
3.5.2	Collections				
3.6	Implementation Issues				
3.6.1	Methods ordering				
3.6.2	Hash-code of Managed Objects				
3.6.3	Default methods of Managed Objects				
3.6.4	Collections of Managed Objects				

Evaluation

- 4.0.1 Research Questions and Answers
- 4.0.2 Evidence

Design Patterns

Undo Concern of JHotDraw

Persistence Concern of JHotDraw

- 4.0.3 Results
- 4.0.4 Claims

Conclusion

Further Work

Acknowledgments

Appendix A

How to Use the Framework

Appendix B

Example Application

- **B.1** Schemas definition
- B.1.1 Point Schema
- B.1.2 Line Schema
- B.2 Data managers definition
- **B.2.1** Basic Data Manager
- B.2.2 Lockable Data Manager
- B.2.3 Observable Data Manager
- **B.3** Tame Aspects
- B.3.1 Immutability
- B.3.2 Logging
- B.3.3 More

Appendix C

Refactoring of JHotDraw's Undo Concern

Bibliography