

Rivar: Reactive Instance Variable

Research Thesis

In Partial Fulfillment of the Requirements for the Degree of
Master of Science in Computer Science



RIVKA ALTSHULER

The Research Thesis Was Done Under
the Supervision of PROF. DAVID H. LORENZ
in the Dept. of Mathematics and Computer Science
The Open University of Israel

Submitted to the Senate of the Open University of Israel
Elul 5772, Raananna, August 2012

Dedicated to...

Acknowledgements

This thesis was made possible with the help and support of ...

The generous support of the Open University Research Authority is acknowledged. This research was supported in part by the *Israel Science Foundation (ISF)* under grant No. 926/08.

Abstract

We combine Reactive Variable with Instance Variable...

List of Publications

- D. H. Lorenz and B. Rosenan. Cedalion: A language for language oriented programming. In *Proceedings of the 26th Annual ACM SIGPLAN Conference on Object-Oriented Programming Systems, Languages, and Applications (OOPSLA' 11)*, pages 733–752, Portland, Oregon, USA, October 2011. ACM. [23]
- D. H. Lorenz and B. Rosenan. Cedalion 101: “I Want My DSL Now” (demo). In *Proceedings of the ACM International Conference on Systems, Programming Languages, and Applications: Software for Humanity (SPLASH'11)*, pages 29–30, Portland, Oregon, USA, Oct. 2011. ACM. [22]
- D. H. Lorenz and B. Rosenan. A Case Study of Language Oriented Programming with Cedalion (poster). In *Proceedings of the ACM International Conference on Systems, Programming Languages, and Applications: Software for Humanity (SPLASH'11)*, pages 199–200, Portland, Oregon, USA, Oct. 2011. ACM. [21]
- B. Rosenan. “Designing language-oriented programming languages.” In *Companion to the ACM International Conference on Systems, Programming Languages, and Applications: Software for Humanity (SPLASH'10)*, pages 207–208, Reno/Tahoe, Nevada, USA, October 2010. ACM Student Research Competition, Second prize. [32]

- D. H. Lorenz and B. Rosenan. “Cedalion: A language-oriented programming language.” In *IBM Programming Languages and Development Environments Seminar*, Haifa, Israel, April 2010. IBM Research. [20]
- D. H. Lorenz and B. Rosenan. “A comparative case study of code reuse with language oriented programming.” *CoRR*, cs.SE/1103.5901, 2011. <http://arxiv.org/abs/1103.5901>. [25]
- D. H. Lorenz and B. Rosenan. “Code reuse with language oriented programming.” In *Proceedings of the 12th International Conference on Software Reuse (ICSR12)*, number 6727 in Lecture Notes in Computer Science, pages 165–180, Pohang, Korea, June 13-17 2011. Springer Verlag. [24]

Contents

List of Publications	vi
List of Figures	x
List of Tables	xi
1 Introduction	1
2 Background	2
2.1 Traditional Paradigms	2
2.2 Union Paradigms	2
3 RIvar Abstraction	3
3.1 Evaluation: Integration with OOP	3
4 Semantics and Implementation	4
4.1 Evaluation: Constraints System	4
5 Case Study	5
5.1 Evaluation: Code Duplication	5
6 Discussion	6
6.1 Cycles	6
6.2 Merge	6
6.3 Glitch	6

7	Conclusion	7
8	Developer Guide	8
9	User Guide	9

List of Figures

List of Tables

Chapter 1

Introduction

Chapter 2

Background

2.1 Traditional Paradigms

2.2 Union Paradigms

Chapter 3

RIvar Abstraction

3.1 Evaluation: Integration with OOP

Chapter 4

Semantics and Implementation

4.1 Evaluation: Constraints System

Chapter 5

Case Study

5.1 Evaluation: Code Duplication

Chapter 6

Discussion

6.1 Cycles

6.2 Merge

6.3 Glitch

Chapter 7

Conclusion

Chapter 8

Developer Guide

Chapter 9

User Guide

Bibliography

- [1] I. Beno, K. Rosenthal, M. Levitine, L. Shaulov, and T. E. Haran. Sequence-dependent cooperative binding of p53 to DNA targets and its relationship to the structural properties of the DNA targets. *Nucleic Acids Research*, 39(5):1919–1932, Mar. 2011.
- [2] M. F. Berger and M. L. Bulyk. Universal protein-binding microarrays for the comprehensive characterization of the DNA-binding specificities of transcription factors. *Nature protocols*, 4(3):393–411, 2009.
- [3] M. L. Bulyk. Protein binding microarrays for the characterization of DNA–protein interactions. *Advances in Biochemical Engineering/Biotechnology*, 104:65–85, 2007. Analytics of Protein–DNA Interactions.
- [4] The Cedalion project homepage. Software Engineering Research Lab, The Open University of Israel, 2010. <http://cedalion.sourceforge.net>.
- [5] *Companion to the ACM International Conference on Systems, Programming Languages, and Applications: Software for Humanity (SPLASH’11)*, Portland, Oregon, USA, October 2011. ACM.
- [6] S. Dmitriev. Language oriented programming: The next programming paradigm. *JetBrains onBoard*, 1(2), 2004.
- [7] S. Erdweg, T. Rendel, C. Kästner, and K. Ostermann. Sugarj: library-based

- syntactic language extensibility. In *Proceedings of the 2011 ACM international conference on Object oriented programming systems languages and applications*, OOPSLA '11, pages 391–406, New York, NY, USA, 2011. ACM.
- [8] M. Flatt. Creating languages in racket. *Commun. ACM*, 55(1):48–56, Jan. 2012.
 - [9] M. Fowler. Projectional editing. Martin Fowler’s Bliki. <http://martinfowler.com/bliki/ProjectionalEditing.htmlx>.
 - [10] M. Fowler. Fluentinterface, 2005. <http://martinfowler.com/bliki/FluentInterface.html>.
 - [11] M. Fowler. Language workbenches: The killer-app for domain specific languages, 2005.
 - [12] S. Freeman and N. Pryce. Evolving an embedded domain-specific language in Java. In *Proceedings of the 21st Annual ACM SIGPLAN Conference on Object-Oriented Programming Systems, Languages, and Applications (OOPSLA’06)*, pages 855–865, Portland, Oregon, USA, October 2006. ACM Press.
 - [13] J. Garrett et al. Ajax: A new approach to web applications. *Adaptive path*, 18, 2005.
 - [14] S. Gunther. Multi-dsl applications with ruby. *IEEE Software*, 27:25–30, 2010.
 - [15] A. Hen-Tov, D. H. Lorenz, A. Pinhasi, and L. Schachter. ModelTalk: When everything is a domain-specific language. *IEEE Software*, 26(4):39–46, 2009. Special issue on Domain-Specific Modeling.
 - [16] P. Hudak. Building domain-specific embedded languages. *ACM Computing Surveys (CSUR)*, 28(4es), 1996.
 - [17] S. C. Johnson. Yacc: Yet another compiler-compiler. Technical Report CSTR32, Bell Laboratories, Murray Hill, NJ, 1975.

- [18] L. C. Kats and E. Visser. The Spoofax language workbench: Rules for declarative specification of languages and IDEs. In *Proceedings of the ACM International Conference on Systems, Programming Languages, and Applications: Software for Humanity (SPLASH'10)*, pages 444–463, Reno/Tahoe, Nevada, USA, October 2010. ACM.
- [19] D. Knuth. Backus normal form vs. Backus Naur form. *Communications of the ACM*, 7(12):735–736, 1964.
- [20] D. H. Lorenz and B. Rosenan. Cedalion: A language oriented programming language. In *IBM Programming Languages and Development Environments Seminar (PLDE'10)*, Haifa, Israel, April 2010. IBM Research.
- [21] D. H. Lorenz and B. Rosenan. A case study of language oriented programming with Cedalion (poster). In Companion to the ACM International Conference on Systems, Programming Languages, and Applications: Software for Humanity (SPLASH'11) [5], pages 199–200.
- [22] D. H. Lorenz and B. Rosenan. Cedalion 101: “I want my DSL now (demo)”. In Companion to the ACM International Conference on Systems, Programming Languages, and Applications: Software for Humanity (SPLASH'11) [5], pages 29–30.
- [23] D. H. Lorenz and B. Rosenan. Cedalion: A language for language oriented programming. In *Proceedings of the 26th Annual ACM SIGPLAN Conference on Object-Oriented Programming Systems, Languages, and Applications (OOPSLA'11)*, pages 733–752, Portland, Oregon, USA, October 2011. ACM.
- [24] D. H. Lorenz and B. Rosenan. Code reuse with language oriented programming. In *Proceedings of the 12th International Conference on Software Reuse (ICSR12)*,

number 6727 in Lecture Notes in Computer Science, pages 165–180, Pohang, Korea, June 13-17 2011. Springer Verlag.

- [25] D. H. Lorenz and B. Rosenan. A comparative case study of code reuse with language oriented programming. *CoRR*, cs.SE/1103.5901, 2011. <http://arxiv.org/abs/1103.5901>.
- [26] D. H. Lorenz and J. Vlissides. Designing components versus objects: A transformational approach. In *Proceedings of the 23th International Conference on Software Engineering (ICSE'01)*, pages 253–262, Toronto, Canada, May 12-19 2001. IEEE Computer Society.
- [27] S. Mellor, A. Clark, and T. Futagami. Model-driven development. *IEEE software*, 20(5):14–18, 2003.
- [28] T. Menzies, J. Black, , J. Fleming, , and M. Dean. An expert system for raising pigs. In *The First Conference on Practical Applications of Prolog (PAP'92)*, 1992.
- [29] M. Mernik, J. Heering, and A. M. Sloane. When and how to develop domain-specific languages. *ACM Comput. Surv.*, 37, Dec. 2005.
- [30] A. Mycroft and R. A. O’Keefe. A polymorphic type system for Prolog. *Artificial intelligence*, 23(3):295–307, 1984.
- [31] L. Renggli and T. Gîrba. Why smalltalk wins the host languages shootout. In *Proceedings of the International Workshop on Smalltalk Technologies (IWST'09)*, pages 107–113, New York, NY, USA, 2009. ACM.
- [32] B. Rosenan. Designing language-oriented programming languages. In *Companion to the ACM International Conference on Systems, Programming Languages, and Applications: Software for Humanity (SPLASH'10)*, pages 207–208,

- Reno/Tahoe, Nevada, USA, October 2010. ACM. Student Research Competition.
- [33] C. Sassenrath. The REBOL scripting language. *Dr. Dobb's Journal: Software Tools for the Professional Programmer*, 25(7):64–68, 2000. <http://rebol.com>.
 - [34] T. Schrijvers, V. S. Costa, J. Wielemaker, and B. Demoen. Towards typed Prolog. In *Proceedings of the 24th International Conference on Logic Programming (ICLP'08)*, pages 693–697, Udine, Italy, 2008. Springer-Verlag.
 - [35] C. Simonyi. The death of computer languages, the birth of intentional programming. Technical Report MSR-TR-95-52, Microsoft Corporation, 1995.
 - [36] C. Simonyi, M. Christerson, and S. Clifford. Intentional software. *ACM SIGPLAN Notices*, 41(10):451–464, 2006.
 - [37] Z. Somogyi, F. Henderson, and T. Conway. Mercury, an efficient purely declarative logic programming language. *Australian Computer Science Communications*, 17:499–512, 1995.
 - [38] T. Stahl and M. Völter. *Model-Driven Software Development: Technology, Engineering, Management*. John Wiley & Sons, 2006.
 - [39] C. Szyperski. *Component Software, Beyond Object-Oriented Programming*. Addison-Wesley, 2nd edition, 2002. With Dominik Gruntz and Stephan Murer.
 - [40] S. Tobin-Hochstadt and M. Felleisen. The design and implementation of typed Scheme. In *Proceedings of the 35th Annual ACM SIGPLAN-SIGACT Symposium on Principles of Programming Languages (POPL'08)*, pages 395–406, San Francisco, California, USA, January 2008. ACM.

- [41] E. Visser. Scannerless generalized-LR parsing. Technical Report P9707, University of Amsterdam, Programming Research Group, Department of Computer Science, Kruislaan 403, NL-1098 SJ Amsterdam, The Netherlands, Aug. 1997.
- [42] M. Völter. Implementing feature variability for models and code with projectional language workbenches. In *Proceedings of the 2nd International Workshop on Feature-Oriented Software Development (FOSD'10)*, pages 41–48, Eindhoven, The Netherlands, Oct. 2010. ACM.
- [43] M. Völter, E. Visser, S. Kelly, A. Hulshout, J. Warmer, P. J. Molina, B. Merkle, and K. Thoms, editors. 2011. <http://www.languageworkbenches.net>.
- [44] M. P. Ward. Language-oriented programming. *Software-Concepts and Tools*, 15(4):147–161, 1994.
- [45] J. Wielemaker. An overview of the SWI-Prolog programming environment. In F. Mesnard and A. Serebrenik, editors, *Proceedings of the 13th International Workshop on Logic Programming Environments (WLPE'03)*, pages 1–16, Mumbai, India, Dec. 2003. Report CW371, Katholieke Universiteit Leuven, Nov. 2003.
- [46] XLR: Extensible language and runtime, 2008. <http://xlr.sourceforge.net/concept/XL.html>.

תוכן העניינים

v	רשימת פרסומים
ix	רשימת איורים
x	רשימת טבלאות
xi	רשימת רישומים
1	1 מבוא
2	1.1 תכנות מונחה היבטים ומערכות לניהול גרסאות
3	1.2 תרומה
5	2 רקע
5	2.1 תכנות מונחה היבטים
7	2.2 מערכות לניהול גרסאות
10	2.3 עבודות בנושא
16	3 הבעיה
16	3.1 ניהול גרסאות ותכנות מונחה היבטים בפרקטיקה
19	3.2 פתרונות נאיביים
21	3.3 המחשה
27	3.4 כשלים בניהול גרסאות
31	4 גישת ניהול גרסאות צולבות
31	4.1 סקירת הפתרון
40	4.2 ארכיטקטורה
43	5 הערכה
43	5.1 חשיבות הבעיה
43	5.2 הערכת הכלי
58	5.3 פונקציונאליות
50	5.4 מגבלות ואיומים על התוקף
52	6 סיכום

תקציר

לכל תזה יש תקציר.

כותרת

חיבור על מחקר

לשם מילוי חלקי של הדרישות לקבלת התואר
מגיסטר למדעים במדעי-המחשב



שם הסטודנט

המחקר נעשה בהנחיית פרופ' דוד לורנץ
במחלקה למתמטיקה ומדעי-המחשב
האוניברסיטה הפתוחה

הוגש לסנט האו"פ
אלול תשע"ב, רעננה, אוגוסט 2012