UNIVERSITEIT VAN AMSTERDAM

MASTERS PROJECT

Representation Mismatch Reduction for Development in Rules-Based Business Engines

Author:
Paul SPENCER

Supervisor:
Dr. Clemens GRELCK

A thesis submitted in fulfillment of the requirements for the degree of Master of Software Engineering

in the

Graduate School of Informatics
Faculty of Science

February 3, 2021

UNIVERSITY OF AMSTERDAM

Declaration of Authorship

I, Paul SPENCER, declare that this thesis titled, "Representation Mismatch Reduction for Development in Rules-Based Business Engines" and the work presented in it are my own. I confirm that:

- This work was done wholly or mainly while in candidature for a research degree at this University.
- Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated.
- Where I have consulted the published work of others, this is always clearly attributed.
- Where I have quoted from the work of others, the source is always given. Except for such quotations, this thesis is entirely my work.
- I have acknowledged all of the main sources of help.
- Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself.

Signed:

Date:

UNIVERSITEIT VAN AMSTERDAM

Abstract

Graduate School of Informatics
Faculty of Science

Master of Software Engineering

Representation Mismatch Reduction for Development in Rules-Based Business Engines

by Paul SPENCER

Context:
Objective:
Method:
Results:
Keywords:
Paper type: Research paper

Acknowledgements

We would like to acknowledge the School of The Gradate school of Informatics in the Faculty of Science at The University of Amsterdam for their guidance, specifically Dr. Clemens Grelck, who has been a supportive, understanding, and available Academic Adviser.

My greatest thanks go out to Toine Khonraad, an alum of this course, who provided me with moral and monetary support, as well as wisdom and friendship that aided in the completion of this, my fourth attempt at getting this project behind me.
...

Contents

List of Figures

List of Tables

Chapter 1

Introduction

In Chapter 2 we present the research questions. Further, the chapter describes the protocol that we use for search strategy, selecting our studies, extracting data from them, and synthesizing the results. Chapter 3 presents the results of our synthesis of data from the primary studies. This is followed, in chapter 4, by a discussion of both the validity of the work and the implications of the findings. We discuss the implications of this study in chapter 5. Finally, the conclusions are presented in chapter 6.

1.0.1 validate bibtex file

[1]
[2]
[3]
[4]
[5]
[6]
[7]
[8]
[9]
[10]
[11]
[12]
[13]
[14]
[15]
[16]
[17]
[18]
[19]
[20]
[21]
[22]
[23]
[24]
[25]
[26]
[27]
[28]
[29]
[30]

[31]
[32]
[33]
[34]

Chapter 2

Method

Chapter 3

Results

Chapter 4

Discussion

4.1 Threats to Validity

4.1.1 Construct Validity

4.1.2 Internal Validity

4.1.3 External Validity

4.1.4 Reliability

4.1.5 Repeatability vs Reproducibility

4.1.6 Method improvement

Chapter 5

Implications to research and practice

5.1 Implications to research

5.2 Future research directions

5.3 Implications to practice

Chapter 6

Conclusion

Appendix A

InterviewTranscripts

Write your Appendix content here.

Bibliography

[1] E. De Ley and D. Jacobs, "Rules-based analysis with jboss drools: Adding intelligence to automation," *Proceedings of ICALEPCS 2011*, pp. 790–793, 2011.

[2] S. Erdweg, T. Van Der Storm, M. Völter, L. Tratt, R. Bosman, W. R. Cook, A. Gerritsen, A. Hulshout, S. Kelly, A. Loh, *et al.*, "Evaluating and comparing language workbenches: Existing results and benchmarks for the future," *Computer Languages, Systems & Structures*, vol. 44, pp. 24–47, 2015.

[3] S. Gregor, "The nature of theory in information systems," *MIS quarterly*, pp. 611–642, 2006.

[4] N. Kumar, D. D. Patil, and V. M. Wadhai, "Rule based programming with drools," *International Journal of Computer Science and Information Technologies*, vol. 2, no. 3, pp. 1121–1126, 2011.

[5] S. Meacham, V. Pech, and D. Nauck, "Classification algorithms framework (caf) to enable intelligent systems using jetbrains mps domain-specific languages environment," *IEEE Access*, vol. 8, pp. 14 832–14 840, 2020.

[6] D. Pavletic, S. A. Raza, M. Voelter, B. Kolb, and T. Kehrer, "Extensible debuggers for extensible languages," *GI/ACM WS on Software Reengineering*, 2013.

[7] D. Ratiu, M. Voelter, and D. Pavletic, "Automated testing of dsl implementations—experiences from building mbeddr," *Software Quality Journal*, vol. 26, no. 4, pp. 1483–1518, 2018.

[8] M. Voelter, B. Kolb, T. Szabó, D. Ratiu, and A. van Deursen, "Lessons learned from developing mbeddr: A case study in language engineering with mps," *Software & Systems Modeling*, vol. 18, no. 1, pp. 585–630, 2019.

[9] M. Voelter, B. Kolb, K. Birken, F. Tomassetti, P. Alff, L. Wiart, A. Wortmann, and A. Nordmann, "Using language workbenches and domain-specific languages for safety-critical software development," *Software & Systems Modeling*, vol. 18, no. 4, pp. 2507–2530, 2019.

[10] P. Vysoky, "Grammar to jetbrains mps convertor," 2016.

[11] A. Wortmann and M. Beet, "Domain specific languages for efficient satellite control software development," *ESASP*, vol. 736, p. 2, 2016.

[12] P. Browne, *JBoss Drools business rules*. Packt Publishing Ltd, 2009.

[13] B. A. Kitchenham, D. Budgen, and P. Brereton, *Evidence-based software engineering and systematic reviews*. CRC press, 2015, vol. 4.

[14] N. J. Mathers, N. J. Fox, and A. Hunn, *Using interviews in a research project*. NHS Executive, Trent, 1998.

[15] M. Voelter, S. Benz, C. Dietrich, B. Engelmann, M. Helander, L. C. Kats, E. Visser, G. Wachsmuth, *et al.*, *DSL engineering: Designing, implementing and using domain-specific languages*. dslbook. org, 2013.

[16] M. Voelter, *Generic tools, specific languages*. Citeseer, 2014.

[17] C. L. Forgy, "Rete: A fast algorithm for the many pattern/many object pattern match problem," in *Readings in Artificial Intelligence and Databases*, Elsevier, 1989, pp. 547–559.

[18] K. Kaczor, G. J. Nalepa, Ł. Łysik, and K. Kluza, "Visual design of drools rule bases using the xtt2 method," in *Semantic methods for knowledge management and communication*, Springer, 2011, pp. 57–66.

[19] S. Erdweg, T. Van Der Storm, M. Völter, M. Boersma, R. Bosman, W. R. Cook, A. Gerritsen, A. Hulshout, S. Kelly, A. Loh, *et al.*, "The state of the art in language workbenches," in *International Conference on Software Language Engineering*, Springer, 2013, pp. 197–217.

[20] S. M. Guttormsen, A. Prinz, and T. Gjøsæter, "Consistent projectional text editors.," in *MODELSWARD*, 2017, pp. 515–522.

[21] H. Liu and M. Parashar, "Dios++: A framework for rule-based autonomic management of distributed scientific applications," in *European Conference on Parallel Processing*, Springer, 2003, pp. 66–73.

[22] T. van der Storm and F. Hermans, "Live literals," in *Workshop on Live Programming (LIVE)*, vol. 2016, 2016.

[23] V. Pech, A. Shatalin, and M. Voelter, "Jetbrains mps as a tool for extending java," in *Proceedings of the 2013 International Conference on Principles and Practices of Programming on the Java Platform: Virtual Machines, Languages, and Tools*, 2013, pp. 165–168.

[24] A. Prinz, "Multi-level language descriptions.," in *MULTI MoDELS*, 2016, pp. 56–65.

[25] M. Proctor, "Drools: A rule engine for complex event processing," in *International Symposium on Applications of Graph Transformations with Industrial Relevance*, Springer, 2011, pp. 2–2.

[26] D. Ratiu, V. Pech, and K. Dummann, "Experiences with teaching mps in industry: Towards bringing domain specific languages closer to practitioners," in *2017 ACM/IEEE 20th International Conference on Model Driven Engineering Languages and Systems (MODELS)*, IEEE, 2017, pp. 83–92.

[27] K.-U. Schmidt, R. Stühmer, and L. Stojanovic, "Blending complex event processing with the rete algorithm," in *Proceedings of iCEP2008: 1st International Workshop on Complex Event Processing for the Future Internet*, Citeseer, vol. 412, 2008.

[28] M. Voelter, J. Siegmund, T. Berger, and B. Kolb, "Towards user-friendly projectional editors," in *International Conference on Software Language Engineering*, Springer, 2014, pp. 41–61.

[29] M. Voelter, A. v. Deursen, B. Kolb, and S. Eberle, "Using c language extensions for developing embedded software: A case study," in *Proceedings of the 2015 ACM SIGPLAN International Conference on Object-Oriented Programming, Systems, Languages, and Applications*, 2015, pp. 655–674.

[30] M. Voelter, "Fusing modeling and programming into language-oriented programming," in *International Symposium on Leveraging Applications of Formal Methods*, Springer, 2018, pp. 309–339.

[31] M. Voelter, K. Birken, S. Lisson, and A. Rimer, "Shadow models: Incremental transformations for mps," in *Proceedings of the 12th ACM SIGPLAN International Conference on Software Language Engineering*, 2019, pp. 61–65.

[32] M. Fowler, *Language workbenches: The killer-app for domain specific languages?* http://martinfowler.com/articles/languageWorkbench.html, Accessed: 2021-02-02, 2005.

[33] *Jrebel java technology report*, https://www.jrebel.com/blog/2020-java-technology-report, Accessed: 2021-01-27.

[34] *Jetbrains mps product page*, https://www.jetbrains.com/mps/, Accessed: 2021-01-19.