Gathering evidence: Model-driven software engineering in automated digital forensics

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Preface

In the summer of 2002 I was invited to interview for the position of software engineer at the Digital Technology department at the Netherlands Forensic Institute (NFI). I ended up as one of the first two software engineers to be hired, and we set up a software engineering-group within the department, dedicated to developing forensic software. Apart from dealing with the engineering challenges that are the subject of this thesis, I was encouraged to develop and spread knowledge in many ways. This included supervising students, teaching users to apply our tools, writing publications and attending conferences.

It didn’t take very long for me to realize that I would like to be involved in the necessary innovations around what we now refer to as automated digital forensics. However, as a self-taught programmer without any formal training, I figured it would be difficult to participate at the forefront of digital forensics technology. So I decided to pursue the necessary education, on the side. At least, that’s how I thought I was going to do it.

I enrolled in a part-time program to obtain a bachelor’s degree in computer science, managing to complete nearly all courses in the first year and spending my free time in the second year writing a thesis. Some courses exposed me to work in the area of programming languages by members of the SWAT-group at Centrum Wiskunde & Informatica (CWI). I discovered this research group had its own master’s program in software engineering at the University of Amsterdam, so I decided to enroll into the full-time program, taking off almost a full year from my work at the NFI.

During my master’s I got interested in program transformation and was allowed to do my thesis research in the SWAT-group at CWI. I saw some clear opportunities to apply the techniques I had been working with to improve digital forensics. Around this time I started wondering whether another step would be possible, such as some kind of co-operation between NFI and CWI to allow me to really pursue some of those ideas. I decided to propose it. This PhD thesis is the result of what happened to that proposal.
Acknowledgements

I owe a debt of gratitude to my promotor Paul Klint, for organizing many important steps that have allowed me to get to the completion of this thesis. Paul always displays a combination of determination and patience that he shows to be crucial for success. Although these traits are exceptionally difficult to reproduce, I will try.

When I started my research at CWI, I expected my co-promotor Tijs van der Storm to help me get up to speed in research and writing. Instead, Tijs has been an incredible mentor, teaching me how to think critically and express myself precisely. I am greatly indebted to him for this, and hope for more collaboration in the future.

I am also grateful to the members of my PhD committee: Jan Bergstra, Zeno Geradts, Cees de Laat, Ralf Lämmel, Richard Paige, and Maarten de Rijke, for their willingness to read my thesis and provide me with thoughtful feedback.

In the past four years when I was doing my research at SWAT, the group transitioned in leadership from Paul Klint to Jurgen Vinju. It is telling that even though the group was built and then lead by Paul for a very long time, nobody seemed to worry about this transition. Working with Jurgen is a pleasure, as he manages to combine strategy and vision with a personal interest in everybody he works with.

I am lucky to have had very supportive co-workers over the years at both the CWI and NFI, of which many have turned into friends along the way. Bas Basten and I have spent many afternoons discussing all conceivable subjects, usually starting out at a technical detail of whatever we were working on and then slowly branching out towards whatever came up.

Mark Hills has been a source of inspiration over the years as I regularly struggled with the complexities of implementing compilers. His deep knowledge and meticulousness has saved me many times. My only regret is that we never got him to try horse meat, even though it really does go wonderfully with pindasaus.

All my papers, and this entire thesis especially, would look a lot less attractive if it weren’t for the help of Davy Landman, who manages to turn any task into an epic engineering endeavor. We seem to have a fully compatible sense of humor, which has greatly enriched my time at SWAT.

For almost the entire four years, I have shared a room with Bert Lisser, who has an almost encyclopedic knowledge of the history of CWI. I will miss our early morning coffee breaks.

I will also miss the other (former) members of SWAT and the software engineering program that I worked with: Ali Afrouzeh, Magiel Bruntink, Hans Dekkers, Jan van Eijck, Mike Godfrey, Paul Griffioen, Pablo Inostroza Valdera, Anastasia Izmaylova, Arnold Lankamp, Robert van Liere, Atze van der Ploeg, Riemer van Rozen, Alexander Serebrenik, Ashim Shahi, Floor Sietsma, Sunil Simon, Michael Steindorfer, Yanjing Wang, and Vadim Zaytsev.
Which brings me to the NFI, where I have been met with similar supportiveness and many friendships. I owe a great deal to Lotte Smelik, both for encouraging me to pursue my research interests by trying to set up a co-operation with CWI as well as for approving the final proposal.

Shortly after I started working on my thesis, Erica Rietveld became department manager and I was somewhat worried whether she would fully support my project. Instead, not only was she supportive, she turned out to understand many of the intricacies of what my research was about, allowing me to focus on it fully.

At the software engineering group, the first seeds of this research were planted in discussions with Arjen van de Wetering, who succeeded me as team lead in 2005. Over the years Arjen has been a great source of inspiration and discussion, even after he left the NFI to work in model-driven engineering.

Leon Aronson combines vision with realism, which often leads to great ideas and occasionally to hilarious insights. He has been a great support over the years, both professionally and personally. Ewald Snel always manages to challenge me whenever I take a couple of technical truths for granted. Stefan Nelwan has been very supportive, helping me to set out a course for the future.

All members of the software engineering-group (past and present) have contributed in various ways to this thesis, for which I am grateful: Erik Aleman, Pelle Barens, Jörgen Bodde, Roel van Dijk, Wendy van Dijk, Michel Frenaij, Mirelle Goos, Jeroen de Jong, Arent de Jongh, Bas Knopper, Sander Kruseman, John Langezaal, Arjen Meijer, Robert Moro, Jolijn Posthuma, Martijn Ras, Jan-Willem Renema, and Allard Siemelink.

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These past years have been exceptionally busy, which have lead me to neglect my best friends, Frans Bouma and Farid Jabli. Nonetheless, they have managed to greatly influence my thinking and research.

Mam en pap, jullie steun en liefde voor mij en mijn gezin zijn een enorme verrijking van ons leven. Dit proefschrift is ook van jullie.

Finally, from the very first ideas to the often difficult deadlines, my wife Nicky has always supported me with advice, understanding, and love. I owe everything to her.

Jeroen van den Bos
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