

Dr Leonid Ryzhyk

Researcher, Samsung Research America

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Research interests

The main theme of my research is applying rigorous formal techniques to the design, implementation, and verification of operating systems. I am particularly interested in techniques that go beyond bug finding and enable strong functional correctness guarantees. For example, I investigate methods for automated synthesis and verification of correct-by-construction device drivers, networks, and file systems.

Employment

- 07/2015 - present Researcher, Samsung Research America.
- 11/2014 - 06/2015 Postdoctoral Fellow, School of Computer Science, Carnegie Mellon University.
- 05/2013 - 10/2014 Postdoctoral Fellow, Electrical and Computer Engineering Department, University of Toronto.
- 09/2009 - 04/2013 Researcher, ERTOS group, NICTA, Sydney, Australia.
- 09/2009 - 04/2013 Conjoint Lecturer, School of Computer Science and Engineering, UNSW, Sydney, Australia.
- 05/2008 - 08/2008 Research Intern, Intel Labs, Hillsboro, OR, USA.
- 09/2004 - 11/2004 Research Intern, ERTOS group, NICTA, Sydney, Australia.
- 09/2000 - 12/2004 Software Developer, WestGate Software Security Inc., Kiev, Ukraine.

Education

- 2005 - 2010 PhD, Computer Science, School of Computer Science and Engineering, UNSW, Sydney, Australia.
Thesis On the Construction of Reliable Device Drivers
Advisor Prof Gernot Heiser
- 2000 - 2002 MSc with honors, Applied Mathematics, Institute for Applied System Analysis, National Technical University of Ukraine, Kiev, Ukraine.
Thesis Operating system architecture based on replicated distributed objects
- 1996 - 2000 BSc with honors, Applied Mathematics, Institute for Applied System Analysis, National Technical University of Ukraine, Kiev, Ukraine.
Thesis Intelligent Software Agents

Awards

- SYNTCOMP 2016 1st place in the Sequential Realizability, 2nd place in the parallel realizability track of the Synthesis Competition , 2016 Synthesis Competition.
- SYNTCOMP 2015 1st place in the Sequential Realizability track of the Synthesis Competition , CAV 2015 Synthesis Competition.
- SYNTCOMP 2014 1st place in the Sequential Realizability track of the Synthesis Competition , 2014 FLoC Olympic Games.

Our game solver, developed jointly with my student Adam Walker, three times in a row won the Sequential Realizability track of the Synthesis Competition in 2014, 2015, and 2016

NICTA Research Award	2012 NICTA Richard E. Newton Award for Research Excellence, for research in automatic device driver synthesis.
NICTA Research Award	Runner-up: 2011 NICTA Richard E. Newton Award for Research Excellence.
NICTA IP Award	2011 NICTA IP Award, for the patent on Co-design of a Testbench and Driver of a Device.
Eurosys 2009	Eurosys PC honorable mention, The "Dingo: Taming Device Drivers" paper received an honorable mention from Eurosys 2009 program committee.

Research grants

05/2013 - 05/2015	\$1.2M grant from Intel Corporation, Automatic Synthesis of High-Assurance Device Drivers. I led a multi-university project, supported by a research grant from Intel, that developed theoretical foundations and practical tools for the creation of correct-by-construction device drivers.
01/2010 - 12/2010	\$50,000 Google Research Award, Automatic Device-Driver Synthesis.

Teaching

2009 - 2012	Lecturer, Advanced Operating Systems (jointly with Gernot Heiser), School of Computer Science and Engineering, UNSW.
2010 - 2012	Lecturer, Operating Systems (jointly with Kevin Elphinstone), School of Computer Science and Engineering, UNSW.
2002 - 2004	Teaching Assistant, Introduction to Digital Circuits, National Technical University of Ukraine.
2002 - 2004	Teaching Assistant, Computer Architecture, National Technical University of Ukraine.

Student Supervision

PhD students

2010-2016	Adam Walker, UNSW and NICTA. Thesis: Automatic Device Driver Synthesis
2011-2012	Sidney Amani, UNSW and NICTA. Thesis: A Formally Verified File System
2012-present	Alexander Legg, UNSW and NICTA. Thesis: SAT-Based Reactive Synthesis

PhD interns

2011	Hui Chen, CNRS, France. Research topic: Symbolic Hardware/Software Co-Simulation
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MSc students

2010	Sidney Amani, EPITECH, France. Thesis: Reliable Device Driver Framework for Linux
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Undergraduate thesis students

2013	Keng Chai Ong, University of Sydney. Thesis: Addressing Performance Bottlenecks in Device Driver Synthesis
2011-2012	Alexander Legg, University of Sydney.

- Thesis: Automatic Firmware Synthesis
2010-2011 Simonne Mautner, UNSW.
Thesis: A Componentized Stackable VFS
2010 Yanjin Zhu, UNSW.
Thesis: Transaction-level Modelling of I/O Devices for Automatic Device Driver Synthesis CiSRA best thesis award
2010 Adrian Ratter, UNSW.
Thesis: Automatic Device Driver Synthesis From Device Specifications CiSRA best thesis award

Research interns

- 2016 Abhiram Balasubramanian, SRA.
Topic: Safe system programming in Rust

Taste of research summer students

- 2012-2013 Keng Chai Ong, University of Sydney.
Project: Design and Implementation of a Garbage Collector for Flash File System
2011-2012 Keng Chai Ong, University of Sydney.
Project: Automatic Verification of Active Driver Protocols NICTA best project award
2011-2012 Adam Black, UNSW.
Project: Reliable Device Driver Framework
2010-2011 Alexander Legg, University of Sydney.
Project: Statechart Compiler NICTA best project award
2009-2010 Alexei Kuzemtchenko, UNSW.
Project: Extracting Software Interfaces from Hardware
2008-2009 Aaron Carroll, UNSW.
Project: Tolerating Device Driver Failures with Automatic Recovery

Service

- PC Chair WRiSE 2011.
PC Member USENIX ATC 2016, SYNT 2015, Eurosys 2013, Eurosys 2011.
Reviewer TACAS 2016, ASPLOS 2016, AAI 2015, ASPLOS 2015, JCST, Software: Practice and Experience, Transactions on Computers, FMCAD 2013, Eurosys 2013, USENIX 2012, SOSP 2011, Eurosys 2011, USENIX 2010, Eurosys 2010, PLOS 2009, Eurosys 2008, RTCSA 2007, Middleware 2006, RTSS 2005.

Languages

- Russian, Ukrainian (First languages)
- English (Fluent)

Publications

Conferences and journals

- [1] Pavol Cerny, Edmund M. Clarke, Thomas A. Henzinger, Arjun Radhakrishna, Leonid Ryzhyk, Roopsha Samanta and Thorsten Tarrach. From Non-preemptive to Preemptive Scheduling using Synchronization Synthesis Formal Methods in System Design, September 2016
- [2] Alexander Legg, Nina Narodytska, Leonid Ryzhyk. A SAT-Based Counterexample Guided Method for Unbounded Synthesis CAV 2016, Toronto, ON, Canada, July 2016
- [3] Pavol Cerny, Edmund M. Clarke, Thomas A. Henzinger, Arjun Radhakrishna, Leonid Ryzhyk, Roopsha Samanta and Thorsten Tarrach. From Non-preemptive to Preemptive Scheduling using Synchronization Synthesis CAV 2015, San Francisco, CA, USA, July 2015
- [4] Niklas Een, Alexander Legg, Nina Narodytska and Leonid Ryzhyk. SAT-based Strategy Extraction in Reachability Games. <http://arxiv.org/abs/1506.08726>
- [5] Adam Walker and Leonid Ryzhyk. Predicate Abstraction for Reactive Synthesis FMCAD 2014, Lausanne, Switzerland, October 2014
- [6] Leonid Ryzhyk, Adam Walker, John Keys, Alexander Legg, Arun Raghunath, Michael Stumm, and Mona Vij. User-Guided Device Driver Synthesis OSDI 2014, Broomfield, CO, USA, October 2014
- [7] Pavol Cerny, Thomas Henzinger, Arjun Radhakrishna, Leonid Ryzhyk and Thorsten Tarrach. Regression-Free Synthesis for Concurrency CAV 2014, Vienna, Austria, July 2014
- [8] Nina Narodytska, Alexander Legg, Fahiem Bacchus, Leonid Ryzhyk, and Adam Walker. Solving Games without Controllable Predecessor CAV 2014, Vienna, Austria, July 2014
- [9] Sidney Amani, Peter Chubb, Alastair Donaldson, Alexander Legg, Keng Chai Ong, Leonid Ryzhyk and Yanjin Zhu. Automatic Verification of Active Device Drivers OSR Journal, 2014
- [10] Mona Vij, John Keys, Arun Raghunath, Scott Hahn, Vincent Zimmer, Leonid Ryzhyk, Adam Walker and Alexander Legg Device Driver Synthesis Intel Technology Journal, Volume 17, Issue 2, December 2013
- [11] Pavol Cerny, Thomas Henzinger, Arjun Radhakrishna, Leonid Ryzhyk and Thorsten Tarrach. Efficient Synthesis for Concurrency using Semantics-Preserving Transformations CAV 2013, Saint Petersburg, Russia, July 2013
- [12] Sidney Amani, Peter Chubb, Alastair Donaldson, Alexander Legg, Leonid Ryzhyk and Yanjin Zhu. Automatic Verification of Message-Based Device Drivers SSV 2012, Sydney, Australia, November 2012
- [13] Leonid Ryzhyk, John Keys, Balachandra Mirla, Arun Raghunath, Mona Vij and Gernot Heiser. Improved Device Driver Reliability through Hardware Verification Reuse. ASPLOS 2011, Newport Beach, CA USA, March, 2011.
- [14] Leonid Ryzhyk, Peter Chubb, Ihor Kuz, Etienne Le Sueur and Gernot Heiser. Automatic Device Driver Synthesis with Termite. SOSP 2009, Big Sky, MT, USA, October 2009.
- [15] Leonid Ryzhyk, Peter Chubb, Ihor Kuz, and Gernot Heiser. Dingo: taming device drivers. Eurosys 2009, Nuremberg, Germany, April 2009, Program committee honorable mention.

Other publications

- [16] Leonid Ryzhyk, Nikolaj Bjørner, Marco Canini, Jean-Baptiste Jeannin, Nina Narodytska, Cole Schlesinger, Douglas B. Terry, and George Varghese Towards Correct-by-Construction SDN NetPL 2016, Florianopolis, Brazil, August 2016
- [17] Swen Jacobs, Roderick Bloem, Romain Brenguier, Ayrat Khalimov, Felix Klein, Robert Könighofer, Jens Kreber, Alexander Legg, Nina Narodytska, Guillermo A. Pérez, Jean-François Raskin, Leonid Ryzhyk, Ocan Sankur, Martina Seidl, Leander Tentrup, Adam Walker The Third Reactive Synthesis Competition (SYNTCOMP 2016)

- [18] Leonid Ryzhyk, Adam Walker. Developing a Practical Reactive Synthesis Tool: Experience and Lessons Learned SYNT 2016, Toronto, ON, Canada, July 2016
- [19] Swen Jacobs, Roderick Bloem, Romain Brenguier, Robert Könighofer, Guillermo A. Pérez, Jean-François Raskin, Leonid Ryzhyk, Ocan Sankur, Martina Seidl, Leander Tentrup, and Adam Walker. The Second Reactive Synthesis Competition (SYNTCOMP 2015)
- [20] Swen Jacobs, Roderick Bloem, Romain Brenguier, Rüdiger Ehlers, Timotheus Hell, Robert Könighofer, Guillermo A. Pérez, Jean-François Raskin, Leonid Ryzhyk, Ocan Sankur, Martina Seidl, Leander Tentrup, and Adam Walker. The First Reactive Synthesis Competition (SYNTCOMP 2014)
- [21] Gabi Keller, Toby Murray, Sidney Amani, Liam O'Connor-Davis, Zilin Chen, Leonid Ryzhyk, Gerwin Klein and Gernot Heiser File systems deserve verification too! PLOS 2013, Nemaquin Woodlands Resort, Farmington, Pennsylvania, USA, November 2013
- [22] Sidney Amani, Leonid Ryzhyk, Alastair Donaldson, Gernot Heiser, Alexander Legg and Yanjin Zhu. Static analysis of device drivers: we can do better! APSys 2011, Shanghai, China, July 2011
- [23] Gernot Heiser, Leonid Ryzhyk, Michael von Tessin, Aleksander Budzynowski What if you could actually Trust your kernel? HotOS 2011, Napa, CA, USA, May 2011
- [24] Gernot Heiser, June Andronick, Kevin Elphinstone, Gerwin Klein, Ihor Kuz and Leonid Ryzhyk. The Road to Trustworthy Systems. 5th Workshop on Scalable Trusted Computing, Chicago, IL, USA, October, 2010.
- [25] Leonid Ryzhyk, John Keys, Balachandra Mirla, Arun Raghunath, Mona Vij and Gernot Heiser. Improved Device Driver Reliability through Verification Reuse. HotDep 2010, Vancouver, BC, Canada, October, 2010.
- [26] Leonid Ryzhyk, Yanjin Zhu and Gernot Heiser. The Case for Active Device Drivers. APSys 2010, New Delhi, India, August 2010.
- [27] Leonid Ryzhyk, Ihor Kuz, and Gernot Heiser. Formalising device driver interfaces. PLOS 2007, Stevenson, Washington, USA, October 2007.
- [28] Leonid Ryzhyk, Timothy Bourke, and Ihor Kuz. Reliable device drivers require well-defined protocols. HotDep 2007, Edinburgh, UK, June 2007.
- [29] Leonid Ryzhyk and Ihor Kuz. Towards operating system support for application-specific fault-tolerance protocols. 2nd International Workshop on Object Systems and Software Architectures, pages 63–67, Victor Harbor, South Australia, Australia, January 2006.
- [30] Leonid Ryzhyk and Anton Burtsev. Architectural design of E1 distributed operating system. 2003.
- [31] Anton Burtsev and Leonid Ryzhyk. Operating system for parallel computing. 3rd International Conference of Students and Young Scientists on System Analysis and Information Technologies, pages 23–27, Kyiv, Ukraine, 2001.

PhD thesis

- [32] Leonid Ryzhyk. On the Construction of Reliable Device Drivers. PhD Thesis, UNSW, Sydney, Australia, January 2010.

Patents

- [33] Leonid Ryzhyk and Gernot Heiser. Co-design of a testbench and driver of a device. USPTO Application #: 20130007330, January 2013.

Academic Referees

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