

# Robert Soulé - Curriculum Vitae

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## Contact Information

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## Education

2012	Ph.D. in Computer Science, New York University. Thesis title: <i>Reusable Software Infrastructure for Stream Processing.</i>
2006	M.Sc. in Computer Science, New York University. Thesis title: <i>Ensuring Content Integrity for Untrusted Peer-to-Peer Content Distribution Networks.</i>
1999	B.A. in Computer Science, Brown University. B.A. in Philosophy, Brown University. B.A. in Art Semiotics, Brown University.

## Employment History

01/2019 - <i>present</i>	<b>Università della Svizzera italiana (USI)</b> , Lugano, Switzerland Associate Professor
01/2014 - 12/2018	<b>Università della Svizzera italiana (USI)</b> , Lugano, Switzerland Assistant Professor
01/2017 - <i>present</i>	<b>Barefoot Networks</b> , Palo Alto, USA Research Scientist
06/2012 - 12/2014	<b>Cornell University</b> , Ithaca, NY, USA Postdoctoral Associate
05/2011 - 09/2011	<b>Massachusetts Institute of Technology</b> , Cambridge, USA Research Assistant
05/2008 - 05/2011	<b>IBM T. J. Watson Research Center</b> , Hawthorne, NY, USA Research Co-op
09/2005 - 09/2006	<b>Morgan Stanley</b> , New York, NY, USA Associate (Application and Data Security)
06/2002 - 09/2005	<b>Bloomberg LP</b> , New York, NY, USA Technical Lead
12/2001 - 06/2002	<b>Tradeware</b> , New York, NY, USA Software Engineer
04/2000 - 10/2001	<b>LimeWire</b> , New York, NY, USA Software Engineer
06/1999 - 04/2000	<b>New Era Of Networks, Inc.</b> , New York, NY, USA Software Engineer

## Awards & Honors

2018	USENIX Symposium on Networked Systems Design and Implementation (NSDI) Best Paper Award
2015	Google Faculty Research Award
2012	ACM International Conference on Distributed Event-Based Systems (DEBS) Best Paper Award
2010	R&D 100 Award For The Most Breakthrough Innovation
2010	IBM Invention Plateau Award
2010	IBM Invention Achievement Award
2006	Henry H. MacCracken Fellowship, New York University.

## Research

### Research Interests

Networking, distributed systems, databases, and applied programming languages.

### Research Projects

01/2019 - 01/2020	Hasler Foundation “Debugging Programmable Data Planes”. 12 months. \$48,636.50 CHF
09/2017 - 09/2018	Western Digital Research Agreement “Consensus for Main Memory”. 12 months. \$45,000 USD
01/2018 - 01/2020	Hasler Foundation “Research Scholarships for Visiting Masters Students”. 24 months. \$50,000 CHF
09/2017 - 09/2021	SNF Project “Exploratory Visual Analytics for Interaction Graphs”. 48 months. \$569,308 CHF
09/2016 - 09/2019	SNF Project “Consensus Protocol Exploiting Network Co-Design”. 36 months. \$377,160 CHF
12/2015 - 12/2018	SNF Project “Online Data Center Modeling”. 36 months. \$347,014 CHF
04/2016 - 04/2018	Hasler Foundation “Research Scholarships for Visiting Masters Students”. 24 months. \$50,000 CHF
02/2015 - 02/2016	Google Award “Online Data Center Modeling”. 12 months. \$136,777 USD

### Supervised PhD Students

02/2015 - <i>present</i>	Daniele Rogora
09/2016 - <i>present</i>	Theo Jepsen
09/2016 - <i>present</i>	Pietro Bressana

### PhD Student Alumni and First Position

09/2014 - 01/2019	Huynh Tu Dang, Western Digital Research
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### Student Awards

2017	Pietro Bressana, SNF Mobility Fellowship
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## Teaching

### University Courses

2016 - 2017	<i>Advanced Networking</i> , MSc, Università della Svizzera italiana
2014 - 2017	<i>Data Management</i> , BSc, Università della Svizzera italiana
2015	<i>Advanced Compilers</i> , MSc, Università della Svizzera italiana
2016	<i>Logic</i> , PhD, Università della Svizzera italiana
2015	<i>Network Programming Languages</i> , PhD, Università della Svizzera italiana and Politecnico di Milano
2014	<i>Domain Specific Languages</i> , MSc, Università della Svizzera italiana
2013	<i>Scripting Languages</i> , MSc, Cornell University

## Service

### Professional Activities

PC Chair	P4 NSDI Hackathon 2019, P4 Sigcomm Tutorial 2018, P4EU 2018, P4 Developer Day Fall 2017, NetPL 2015-2016, DSDN 2016
PC Member	SIGCOMM 2019, SOSR 2019, EuroSys 2019, DEBS 2018, SOSR 2018, SOSR 2017 (Posters and Demos), PODC 2017, ReConFig 2016, OPODIS 2016, SIGCOMM 2016 (Posters and Demos), CoNEXT 2016, PLDI 2016 (ERC), ECOOP 2016 (ERC), EuroSys 2016, ANCS 2016, Middleware 2014-2015, OOPSLA 2015, HPC4BD 2015-2017
Reviewer	TSE, SP&E, IBM JR&D, Computer Networks

## Publications

### Journal Articles

1. Robert Soulé, Shrutarshi Basu, Parisa Jalili Marandi, Fernando Pedone, Robert Kleinberg, Emin Gün Sirer, Nate Foster. Merlin: A Language for Provisioning Network Resources. In *IEEE/ACM Transactions on Networking (ToN)*, 26(5), October 2018.
2. Martin Hirzel, Robert Soulé, Buğra Gedik, and Scott Schneider. Stream query optimization. *Encyclopedia of Big Data Technologies*, April 2018.
3. Huynh Tu Dang, Marco Canini, Fernando Pedone, and Robert Soulé. Paxos Made Switch-y. In *SIGCOMM Computer Communication Review (SIGCOMM CCR)*, February 2016.
4. Robert Soulé and Buğra Gedik. RailwayDB: Adaptive Storage of Interaction Graphs. In *Very Large Data Bases Journal (VLDBJ)*, 25(2), pp. 151-169 March 2016.
5. Robert Soulé, Martin Hirzel, Buğra Gedik, Robert Grimm. River: An Intermediate Language for Stream Processing. In *Software: Practice and Experience (SP&E)*, 2015.
6. Martin Hirzel, Robert Soulé, Scott Schneider, Buğra Gedik, and Robert Grimm. A Catalog of Stream Processing Optimizations. *ACM Computing Surveys (CSUR)*. 46(4), April 2014.
7. Martin Hirzel, Henrique Andrade, Buğra Gedik, Gabriela Jacques da Silva, Rohit Khandekar, Vibhor Kumar, Mark Mendell, Howard Nasgaard, Scott Schneider, Robert Soulé, Kun-Lung Wu. IBM Streams Processing Language: Analyzing Big Data in Motion. *IBM Journal on Research and Development (JRD)*, pp. 1-11, 57(3), May 2013.

### Conference Publications

8. Long Hoang Le, Enrique Fynn, Mojtaba Eslahi-Kelorazi, Robert Soulé, and Fernando Pedone. DynaStar: Optimized Dynamic Partitioning for Scalable State Machine Replication. In *Proceedings of the 39th IEEE International Conference on Distributed Computing Systems (ICDCS '19)*, July 2019. (N/A)
9. Theo Jepsen, Daniel Alvarez, Nate Foster, Changhoon Kim, Jeongkeun Lee, Masoud Moshref, and Robert Soulé. Fast String Searching on PISA. In *Proceedings of the 5th Symposium on SDN Research (SOSR '19)*, April 2019. Acceptance rate: 28% (15/53).
10. Yuta Tokusashi, Huynh Tu Dang, Fernando Pedone, Robert Soulé, and Noa Zilberman. In *Proceedings of the 2019 European Conference on Computer Systems (EuroSys '19)*, March 2019. Acceptance rate: 22% (45/121).
11. Calin Cascaval, Nate Foster, William Hallahan, Jeongkeun Lee, Jed Liu, Nick McKeown, Cole Schlesinger, Milad Sharif, Robert Soulé, and Han Wang. p4v: Practical Verification for Programmable Data Planes. In *Proceedings of the 2018 ACM SIGCOMM Conference on Applications, Technologies, Architectures, and Protocols for Computer Communications (SIGCOMM '18)*, August 2018. Acceptance rate: 18% (40/222).
12. Praveen Kumar, Yang Yuan, Chris Yu, Nate Foster, Robert Kleinberg, Petr Lapukhov, Chiun Lin Lim, and Robert Soulé. Semi-Oblivious Traffic Engineering: The Road Not Taken. In *Proceedings of the 15th USENIX Symposium on Networked Systems Design and Implementation (NSDI '18)*, April 2018. Acceptance rate: 16% (40/252).

13. Xin Jin, Xiaozhou Li, Haoyu Zhang, Nate Foster, Jeongkeun Lee, Robert Soulé, Changhoon Kim, and Ion Stoica. NetChain: Scale-Free Sub-RTT Coordination. In *Proceedings of the 15th USENIX Symposium on Networked Systems Design and Implementation (NSDI '18)*, April 2018. Acceptance rate: 16% (40/252). **Best Paper Award**.
14. Theo Jepsen, Masoud Moshref, Antonio Carzaniga, Nate Foster, and Robert Soulé. Life in the Fast Lane: A Line-Rate Linear Road. In *Proceedings of the 4th Symposium on SDN Research (SOSR '18)*, March 2018. Acceptance rate: 28% (18/63).
15. Praveen Kumar, Chris Yu, Yang Yuan, Nate Foster, Robert Kleinberg, and Robert Soulé. YATES: Rapid Prototyping for Traffic Engineering Systems. In *Proceedings of the 4th Symposium on SDN Research (SOSR '18)*, March 2018. Acceptance rate: 28% (18/63).
16. Xin Jin, Xiaozhou Li, Haoyu Zhang, Robert Soulé, Jeongkeun Lee, Nate Foster, Changhoon Kim, and Ion Stoica. NetCache: Balancing Key-Value Stores with Fast In-Network Caching. In *Proceedings of the 26th ACM Symposium on Operating Systems Principles (SOSP '17)*, October 2017. Acceptance rate: 17% (39/232).
17. Nik Sultana, Salvator Galea, David Greaves, Marcin Wojcik, Jonny Shipton, Richard Clegg, Luo Mai, Pietro Bressana, Robert Soulé, Richard Mortier, Paolo Costa, Peter Pietzuch, Jon Crowcroft, Andrew W Moore, and Noa Zilberman. Emu: Rapid Prototyping of Networking Services. In *Proceedings of the 2017 USENIX Annual Technical Conference (USENIX ATC '17)*, July 2017. Acceptance rate: 21% (60/283).
18. Huynh Tu Dang, Han Wang, Theo Jepsen, Gordon Brebner, Changhoon Kim, Jennifer Rexford, Robert Soulé, and Hakim Weatherspoon. Whippersnapper: A P4 Language Benchmark Suite. In *Proceedings of the 3rd ACM Sigcomm Symposium on SDN Research (SOSR '17)*, April 2017. Acceptance rate: 23% (18/77).
19. Han Wang, Robert Soulé, Huynh Tu Dang, Ki Suh Lee, Vishal Shrivastav, Nate Foster, and Hakim Weatherspoon. P4FPGA: A Rapid Prototyping Framework for P4. In *Proceedings of the 3rd ACM Sigcomm Symposium on SDN Research (SOSR '17)*, April 2017. Acceptance rate: 23% (18/77).
20. Ricardo Padilha, Enrique Fynn, Robert Soulé, and Fernando Pedone. Callinicos: Robust Transactional Storage for Distributed Data Structures. In *Proceedings of the 2016 USENIX Annual Technical Conference (USENIX ATC '16)*, June 2016. Acceptance rate: 18% (47/266).
21. Huynh Tu Dang, Daniele Sciascia, Marco Canini, Fernando Pedone, and Robert Soulé. NetPaxos: Consensus at Network Speed. In *Proceedings of the 1st ACM Sigcomm Symposium on SDN Research (SOSR '15)*, June 2015. Acceptance rate: 20% (27/137).
22. Robert Soulé, Shrutarshi Basu, Parisa Jalili Marandi, Fernando Pedone, Robert Kleinberg, Emin Gün Sirer, and Nate Foster. Merlin: A Language for Provisioning Network Resources. In *Proceedings of the 10th International Conference on emerging Networking Experiments and Technologies (CoNEXT '14)*, December 2014. Acceptance rate: 19% (37/186).
23. Lonnie Princehouse, Rakesh Chenchu, Zhefu Jiang, Ken Birman, Nate Foster, and Robert Soulé. MiCA: A Compositional Architecture for Gossip Protocols. In *Proceedings of the 28th European Conference on Object-Oriented Programming (ECOOP '14)*, July 2014. Acceptance rate: 27% (27/101).
24. Robert Soulé, Michael I. Gordon, Saman Amarasinghe, Robert Grimm, and Martin Hirzel. Dynamic Expressivity with Static Optimization for Streaming Languages. In *Proceedings of the 7th ACM International Conference on Distributed Event-Based Systems (DEBS '13)*, July 2013. Acceptance rate: 27.5% (16/58).
25. Robert Soulé, Martin Hirzel, Buğra Gedik, and Robert Grimm. From a Calculus to an Execution Environment for Stream Processing. In *Proceedings of the 6th ACM International Conference on Distributed Event-Based Systems (DEBS '12)*, pp. 20–31, July 2012. Acceptance rate: 21% (17/79). **Best Paper Award**.
26. Giuliano Losa, Vibhore Kumar, Henrique Andrade, Buğra Gedik, Martin Hirzel, Robert Soulé, and Kun-Lung Wu. Language and System Support for Efficient State Sharing in Distributed Stream Processing Systems. In *Proceedings of the 6th ACM International Conference on Distributed Event-Based Systems (DEBS '12)* (Industrial Track), July 2012. pp. 268–277. Acceptance rate: 80% (8/10).

27. Qiong Zou, Huayong Wang, Robert Soulé, Martin Hirzel, Henrique Andrade, Buğra Gedik, and Kun-Lung Wu. From a Stream of Relational Queries to Distributed Stream Processing. In *Proceedings of the VLDB Endowment (VLDB '10)* (Industrial Track), pp. 1394–1405, volume 3, number 2, September 2010. Acceptance rate: 24% (12/51).
28. Robert Soulé, Martin Hirzel, Robert Grimm, Buğra Gedik, Henrique Andrade, Vibhore Kumar, and Kun-Lung Wu. A Universal Calculus for Stream Processing Languages. In *Proceedings of the 19th European Symposium on Programming (ESOP '10)*, pp. 507–528, volume 6012 of *Lecture Notes in Computer Science*, Springer-Verlag, March 2010. Acceptance rate: 25% (30/121).
29. Nalini Belaramani, Jiandan Zheng, Amol Nayate, Robert Soulé, Mike Dahlin, and Robert Grimm. PADS: A Policy Architecture for Distributed Storage Systems. In *Proceedings of the 6th USENIX Symposium on Networked Systems Design and Implementation (NSDI '09)*, pp. 59–73, April 2009. Acceptance rate: 20% (32/163).
30. Nikolaos Michalakis, Robert Soulé, and Robert Grimm. Ensuring content integrity for untrusted peer-to-peer content distribution networks. In *Proceedings of the 4th USENIX Symposium on Networked Systems Design and Implementation (NSDI '07)*, pp. 145–158, April 2007. Acceptance rate: 24% (27/113).

### Workshop Publications

31. Theo Jepsen, Masoud Moshref, Antonio Carzaniga, Nate Foster, and Robert Soulé. Packet Subscriptions for Programmable ASICs. In *Proceedings of the 17th ACM Workshop on Hot Topics in Networks (HotNets '18)*, November 2018. Acceptance rate: 21% (26/125).
32. Huynh Tu Dang, Jaco Hofmann, Yang Liu, Marjan Radi, Dejan Vucinic, Fernando Pedone, Robert Soulé. Consensus for Non-Volatile Main Memory. In *Proceedings of the 1st European P4 Workshop (P4EU '18)*, August 2018. Acceptance rate: 35% (6/17).
33. Theo Jepsen, Leandro Pacheco de Sousa, Masoud Moshref, Fernando Pedone, and Robert Soulé. Infinite Resources for Optimistic Concurrency Control. In *Proceedings of the ACM SIGCOMM 2018 Workshop on In-Network Computing (NetCompute '18)*, August 2018. Acceptance rate: 54% (6/11).
34. Daniele Rogora, Steffen Smolka, Antonio Carzaniga, Amer Diwan, and Robert Soulé. Performance Annotations for Cloud Computing. In *Proceedings of the 9th USENIX Workshop on Hot Topics in Cloud Computing (HotCloud '17)*, July 2017. Acceptance rate: 33% (19/58).
35. Robert Soulé, Shrutarshi Basu, Robert Kleinberg, Emin Gün Sirer, and Nate Foster. Managing the Network with Merlin. In *Proceedings of the 12th ACM Workshop on Hot Topics in Networks (HotNets '13)*, November 2013. Acceptance rate: 24% (26/110).

### Refereed Posters and Presentations

36. Pietro Bressana, Noa Zilberman, and Robert Soulé. A Programmable Framework for Validating Data Planes. In *Proceedings of the 2018 ACM SIGCOMM Conference on Applications, Technologies, Architectures, and Protocols for Computer Communications (SIGCOMM '18)*, August 2018. Acceptance rate: 43% (52/121).
37. Praveen Kumar, Yang Yuan, Chris Yu, Nate Foster, Robert Kleinberg, Petr Lapukhov, Chiun Lin Lim, and Robert Soulé. Semi-Oblivious Traffic Engineering with SMORE. In *ACM, IRTF, and, ISOC Applied Networking Research Workshop (ANRW '18)*, July 2018. Acceptance rate: 59% (33/56).
38. Theo Jepsen, Leandro Pacheco de Sousa, Huynh Tu Dang, Fernando Pedone, Robert Soulé. Gotthard: Network Support for Transaction Processing. In *Proceedings of the 3rd ACM Sigcomm Symposium on SDN Research (SOSR '17)*, April 2017.
39. Salvator Galea, Nik Sultana, Pietro Bressana, David Greaves, Andrew W. Moore, Robert Soulé, and Noa Zilberman. Emu: Rapid FPGA Prototyping of Network Services in C#. In *Design, Automation, and Test in Europe (DATE '17)*, March 2017.

40. Robert Soulé, Ken Birman, Nate Foster. Software Defined Networks and Gossip Protocols. In *The 8th Workshop on Large Scale Distributed Systems and Middleware (LADIS '14)*, October 2014. Acceptance rate: 81% (17/21).
41. Robert Soulé, Shrutarshi Basu, Robert Kleinberg, Emin Gün Sirer, Nate Foster. Merlin: Programming the Big Switch. In *The Open Networking Summit (ONS '14)*, March 2014. Acceptance rate: 50% (46/92).
42. Shrutarshi Basu, Robert Soulé, Robert Kleinberg, Emin Gün Sirer, Nate Foster. Merlin: Unified Management for Diverse Networks. Work-in-progress presentation and poster at the *24th ACM Symposium on Operating Systems Principles (SOSP '13)*, November 2013.
43. Robert Soulé, Martin Hirzel, Robert Grimm, Buğra Gedik. Distributed CQL Made Easy. Extended abstract and presentation at the *New England Database Summit (NEDB '11)*, January 2011. Acceptance rate: 50% (11/22).
44. Martin Hirzel, Henrique Andrade, Buğra Gedik, Vibhore Kumar, Giuliano Losa, Robert Soulé, Kun-Lung Wu. Spade: Opening the Levees for Stream Processing. Presentation at the *IBM Programming Languages Day*, May 2009.
45. Robert Soulé, Robert Grimm, and Petros Maniatis. Auto-Parallelization for Declarative Network Monitoring. Poster at the *21st ACM Symposium on Operating Systems Principles (SOSP '07)*, October 2007.
46. Nikolaos Michalakis, Robert Soulé, and Robert Grimm. Taking the trust out of global-scale web services. Work-in-progress presentation at the *7th USENIX Symposium on Operating Systems Design and Implementation (OSDI '06)*, November 2006.

#### Other Publications

47. Huynh Tu Dang, Pietro Bressana, Han Wang, Ki Suh Lee, Noa Zilberman, Hakim Weatherspoon, Marco Canini, Fernando Pedone, and Robert Soulé. Partitioned Paxos via the Network Data Plane. Università della Svizzera italiana Faculty of Informatics Technical Report USI-INF-TR-2019-01 January 2019.
48. Martin Hirzel, Henrique Andrade, Buğra Gedik, Vibhore Kumar, Giuliano Losa, Mark Mendell, Howard Nasgaard, Robert Soulé, Kun-Lung Wu. Streams Processing Language Specification. IBM Research Report RC24897, IBM T. J. Watson Research Center, November 2009. Supersedes RC24830, July 2009 and RC24760, March 2009.

#### Patents

1. John Nathan Foster, Jeongkeun Lee, Robert Soulé, William Hallahan, Cole Nathan Schlesinger, Han Wang, Steffen Julif Smolka. Data Plane Program Verification. US Patent Application 16/022,601, June 2018.
2. Changhoon Kim, Jeongkeun Lee, Milad Sharif, Robert Soulé. Source Routing Design with Simplified Forwarding Elements. US Patent Application 15/948,946, April 2018.
3. Changhoon Kim, Jeongkeun Lee, Milad Sharif, Robert Soulé. Forwarding Element for Network with Routing Performed at Edges. US Patent Application 62/640,559, April 2018.
4. Changhoon Kim, Jeongkeun Lee, Milad Sharif, Robert Soulé. Generation of Path Failure Message at Forwarding Element. US Patent Application 15/948,991, April 2018.
5. Changhoon Kim, Jeongkeun Lee, Milad Sharif, Robert Soulé. Execution of Packet-Specified Actions at Forwarding Element. US Patent Application 15/948,992, April 2018.
6. Changhoon Kim, Jeongkeun Lee, Milad Sharif, Robert Soulé. Verification of Access Control List Rules. US Patent Application 15/948,990, April 2018.
7. Marco Canini, Huynh Tu Dang, Fernando Pedone, Robert Soulé. Improvement of Storage and Replication in Distributed Computing Environments Issued as Patent 10,248,708, in U.S.A., April 2, 2019.
8. Henrique Andrade, Buğra Gedik, Martin Hirzel, Vibhore Kumar, Giuliano Losa, Robert Soulé, and Kun-Lung Wu. Data Sharing in a Stream Processing System. Issued as Patent 8560602, in U.S.A., October 2013.

9. Henrique Andrade, Jim Challenger, Buğra Gedik, Robert Grimm, Martin Hirzel, Vibhore Kumar, Robert Soulé, Kun-Lung Wu. Virtual Execution Environment for Streaming Languages. Issued as Patent 8499292 in U.S.A., July 30, 2013.
10. Henrique Andrade, Buğra Gedik, Martin Hirzel, Robert Soulé, Huayong Wang, Kun-Lung Wu, Qiong Zou. Transforming Relational Queries Into Stream Processing. Issued as Patent 8326821 in U.S.A., December 4, 2012.
11. Henrique Andrade, Buğra Gedik, Martin Hirzel, Robert Soulé, Huayong Wang, Kun-Lung Wu, Qiong Zou. Proxying ODBC Calls. Issued as Patent 8321443 in U.S.A, November 27, 2012.
12. Henrique Andrade, Buğra Gedik, Martin Hirzel, Vibhore Kumar, Robert Soulé, Kun-Lung Wu. State Sharing in a Distributed Data Stream Processing System. Issued as Patent 8285780 in U.S.A., October 9, 2012.