

Nate Foster

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Education

- PhD, Computer and Information Science, University of Pennsylvania, 2009.
Dissertation: *Bidirectional Programming Languages*, advised by Benjamin C. Pierce.
- MPhil, History and Philosophy of Science, University of Cambridge, 2008.¹
Dissertation: *Indexicals and Belief Reports*, advised by Martin Kusch.
- BA, Computer Science, Williams College, 2001.
Honors thesis: *Rupiah: Towards an Expressive Static Type System for Java*, advised by Kim B. Bruce.

Academic Positions

- Associate Dean for Research, Cornell University, Bowers CIS, 2022–2023 (Interim), 2024–present.
- Professor, Cornell University, 2021–present.
- Associate Professor, Cornell University, 2016–2021.
- Assistant Professor, Cornell University, 2010–2016.
- Postdoctoral Research Associate, Princeton University, September 2009–June 2010.

Visiting Positions

- Visiting Professor, École Polytechnique Fédérale de Lausanne, 2023–2024.
- Visiting Assistant Professor, Stanford University, 2016–2017.

Industry Positions

- Visiting Researcher, Jane Street, 2022, 2023–present.
- Platform Architect, Intel, 2019–2023.
- Principal Research Engineer, Barefoot Networks, 2016–2019.

Awards

- ACM SIGPLAN Robin Milner Young Researcher Award, 2023.
- ACM SIGCOMM Rising Star Award, 2018.
- CAREER Award, National Science Foundation, 2013.
- Research Fellowship, Alfred P. Sloan Foundation, 2012.
- Graduate Research Fellowship, National Science Foundation, 2003.
- Herchel Smith Fellowship, Emmanuel College Cambridge, 2001.

¹All work for the MPhil was completed in 2003, but I did not formally receive my degree until a ceremony in 2008.

Paper Awards

- OOPSLA Distinguished Paper Award, “Formal Abstractions for Packet Scheduling,” 2023.
- ICFP Most Influential Paper Award, “Frenetic: A Network Programming Language,” 2021.
- CoNEXT Best Paper Award, “Forwarding and Routing with Packet Subscriptions,” 2020.
- POPL Distinguished Paper Award, “Guarded Kleene Algebra with Tests: Verification of Uninterpreted Programs in Nearly Linear Time,” 2020.
- SIGCOMM Best Student Paper Award, “PicNIC: Predictable Virtualized NIC,” 2019.
- NSDI Best Paper Award, “NetChain: Scale-Free Sub-RTT Coordination,” 2018.
- SIGPLAN Research Highlight, “A Fast Compiler for NetKAT,” 2016.
- POPL Most Influential Paper Award, “Combinators for Bidirectional Tree Transformations: A Linguistic Approach to the View Update Problem,” 2015.
- NSDI Community Award, “Composing Software-Defined Networks,” 2013.

University Awards

- Cornell Bowers Computing and Information Science Research Excellence Award, 2022.
- Cornell Engineering Research Excellence Award, 2015.
- James and Mary Tien Teaching Award, College of Engineering, Cornell University, 2018.
- Tien '72 Teaching Award, College of Engineering, Cornell University, 2013.

Journal Articles

- E. H. Campbell, H. Hojjat, N. Foster. October 2024. Computing Precise Control Interface Specifications. *Proceedings of the ACM Transactions on Programming Languages (PACM, OOPSLA2, acceptance rate 34%)*. 8(303):1–24.
- M. Moeller, J. Jacobs, O. S. Belanger, D. Darais, C. Schlesinger, S. Smolka, N. Foster, A. Silva. June 2024. KATch: A Fast Symbolic Verifier for NetKAT. *Proceedings of the ACM Transactions on Programming Languages (PACM, PLDI, acceptance rate 26%)*. 8(224):1–23.
- A. Mohan, Y. Liu, N. Foster, T. Kappé, D. Kozen. October 2023. Formal Abstractions for Packet Scheduling. *Proceedings of the ACM Transactions on Programming Languages (PACM, OOPSLA, acceptance rate 37%)*. 7(269):1–28.
- J. Grimmelman, S. Basu, N. Foster, R. Richardson, S. Parikh. A Programming Language for Estates and Future Interests. May 2022. *Yale Journal of Law and Technology (YJOLT)*. 24:75.
- M. Eichholz, E. H. Campbell, M. Krebs, N. Foster, M. Mezini. January 2022. Dependently-Typed Data Plane Programming. *Proceedings of the ACM Transactions on Programming Languages (PACM, POPL, acceptance rate 23%)*. 6(40):1–28.
- R. Doenges, M. T. Arashloo, S. Bautista, A. Chang, N. Ni, S. Parkinson, R. Peterson, A. Solko-Breslin, A. Xu, N. Foster. January 2021. Petr4: Formal Foundations for P4 Data Planes. *Proceedings of the ACM Transactions on Programming Languages (PACM, POPL, acceptance rate 21%)*. 5(41):1–32.
- S. Smolka, N. Foster, J. Hsu, T. Kappé, D. Kozen, A. Silva. Guarded Kleene Algebra with Tests: Verification of Uninterpreted Programs in Nearly Linear Time. January 2020. *Proceedings of the ACM Transactions on Programming Languages (PACM, POPL, acceptance rate 28%)*, 4(61): 1–28.
- R. Soulé, S. Basu, P. J. Marandi, F. Pedone, R. Kleinberg, E. G. Sirer, and N. Foster. Merlin: A Language for Managing Network Resources. *IEEE/ACM Transactions on Networking (ToN)*. 26(5): 2188–2201 (2018).

- M. Casado, N. Foster, and A. Guha. Abstractions for Software-Defined Networks. October 2014. *Communications of the ACM (CACM)*, 57(10):86–95.
- N. Foster, M. J. Freedman, A. Guha, R. Harrison, N. P. Katta, C. Monsanto, J. Reich, M. Reitblatt, J. Rexford, C. Schlesinger, A. Story, D. Walker. Languages for software-defined networks. February 2013. *IEEE Communications Magazine*, 51(2): 128–134.
- R. Rajkumar, N. Foster, S. Lindley, J. Cheney. Lenses for Web Data. December 2013. *Electronic Communication of the European Association of Software Science and Technology (EASST)*, 57.
- Foster, J. N. and Karvounarakis G. Provenance and Data Synchronization. December 2007. *IEEE Data Engineering Bulletin, Special Issue on Provenance*, 30(4):13–21.
- J. N. Foster, M. B. Greenwald, J. T. Moore, B. C. Pierce, and A. Schmitt. Combinators for Bidirectional Tree Transformations: A Linguistic Approach to the View Update Problem. May 2007. *ACM Transactions on Programming Languages and Systems*, 27(3):17.
- J. N. Foster, M. B. Greenwald, C. Kirkegaard, B. C. Pierce, and A. Schmitt. Exploiting Schemas in Data Synchronization. January 2007. *Journal of Computer and System Sciences*, 73(4):669–689.

Refereed Conference Publications

- F. Ruffy, J. Liu, P. Kotikalapudi, V. Havel, H. Tavante, R. Sherwood, V. Dubina, V. Peschanenko, A. Sivaraman, N. Foster. P4Testgen: An Extensible Test Oracle For P4-16. September 2023. Conference of the ACM Special Interest Group on Data Communication (SIGCOMM, acceptance rate 22%), New York, NY, pp. 136–151.
- S. Renganathan, B. Rubin, H. Kim, P. L. Ventre, C. Cascone, D. Moro, C. Chan, N. McKeown, N. Foster. Hydra: Effective Runtime Network Verification. September 2023. Conference of the ACM Special Interest Group on Data Communication (SIGCOMM, acceptance rate 22%), New York, NY, pp. 182–194.
- M. Moeller, T. Wiener, A. Solko-Breslin, C. Koch, N. Foster, A. Silva. Automata Learning with an Incomplete Teacher. July 2023. European Conference on Object-Oriented Programming (ECOOP), Seattle, WA pp. 21:1–21:30.
- R. Peterson, E. H. Campbell, J. Chen, N. Isak, C. Shyu, R. Doenges, P. Ataei, N. Foster. P4Cub: A Little Language for Big Routers. January 2023. ACM SIGPLAN Conference on Certified Programs and Proofs (CPP, acceptance rate 47%), Boston, MA, pp. 303–319.
- R. Doenges, T. Kappé, J. Sarracino, N. Foster, and G. Morrisett. Leapfrog: Certified Equivalence for Protocol Parsers. June 2022. ACM SIGPLAN Conference on Programming Language Design and Implementation (PLDI, acceptance rate 19%), San Diego, CA, pp. 950–965.
- J. Wagemaker, N. Foster, T. Kappé, D. Kozen, J. Rot, A. Silva. Concurrent NetKAT. April 2022. European Symposium on Programming (ESOP, acceptance rate 33%), Munich, Germany, pp. 575–602.
- E. Campbell, W. Hallahan, P. Srikumar, C. Cascone, J. Liu, V. Ramamurthy, H. Hojjat, R. Piskac, R. Soulé, N. Foster. Avenir: Managing Data Plane Diversity with Control Plane Synthesis. April 2021. USENIX Symposium on Networked Systems Design and Implementation (NSDI, acceptance rate 16%), Virtual Event, pp. 133–153.
- T. Jepsen, A. Fattaholmanan, M. Moshref, N. Foster, A. Carzaniga, R. Soulé. Forwarding and Routing with Packet Subscriptions. December 2020. ACM SIGCOMM Conference on emerging Networking Experiments and Technologies (CoNEXT, acceptance rate 25%), Virtual Event, pp. 282–294.
- H. Soni, M. Rifai, R. Kumar, R. Doenges, N. Foster. Composing Dataplane Programs with μ P4. August 2020. Conference of the ACM Special Interest Group on Data Communication (SIGCOMM, acceptance rate 21%), Virtual Event, pp. 329–343.

- J. DiLorenzo, K. Mancini, K. Fisher, N. Foster. TxForest: A DSL for Concurrent Filestores. December 2019. Asian Symposium on Programming Languages and Systems (ASPLAS, acceptance rate 44%), Bali, Indonesia, pp. 332–354.
- C. Skalka, J. Ring, D. Darais, M. Kwon, S. Gupta, K. Diller, S. Smolka, N. Foster. Proof-Carrying Network Code. November 2019. ACM SIGSAC Conference on Computer and Communications Security (CCS, acceptance rate 16%), London, UK, pp. 1115–1129.
- S. Basu, N. Foster, J. Grimmelmann. Property Conveyances as a Programming Language. October 2019. ACM SIGPLAN International Symposium on New Ideas, New Paradigms, and Reflections on Programming and Software (Onward!, acceptance rate 59%), pp. 128–142.
- P. Kumar, N. Dukkupati, N. Lewis, Y. Cui, Y. Wang, C. Li, V. Valancius, J. Adriaens, S. Gribble, N. Foster, A. Vahdat. PicNIC: Predictable Virtualized NIC. August 2019. Conference of the ACM Special Interest Group on Data Communication (SIGCOMM, acceptance rate 14%), Beijing, China, pp. 351–366.
- M. Eichholz, E. Campbell, N. Foster, G. Salvaneschi, M. Mezini. How to Avoid Making a Billion-Dollar Mistake: Type-Safe Data Plane Programming with SafeP4. July 2019. European Conference on Object-Oriented Programming (ECOOP, acceptance rate 37%), London UK, paper 12.
- S. Smolka, P. Kumar, N. Foster, J. Hsu, D. Kozen, and A. Silva. Scalable Verification of Probabilistic Network Programs. ACM SIGPLAN Conference on Programming Language Design and Implementation (PLDI, acceptance rate 28%), Phoenix, AZ, June 2019.
- T. Magrino, J. Liu, N. Foster, J. Gehrke, and A. C. Myers. Efficient, Consistent Distributed Computation with Predictive Treaties. March 2019. European Conference on Computer Systems (EuroSys, acceptance rate 22%), Dresden, Germany, paper 36.
- T. Jepsen, D. Alvarez, N. Foster, C. Kim, J. Lee, M. Mosharef, R. Soulé. Fast String Searching on PISA. April 2019. ACM SIGCOMM Symposium on Software-Defined Networks (SOSR, acceptance rate 28%), San Jose, CA, 21–28.
- J. Liu, W. T. Hallahan, C. Schlesinger, M. Sharif, J. Lee, R. Soulé, H. Wang, C. Cascaval, N. McKeown, and N. Foster. p4v: practical verification for programmable data planes. August 2018. Conference of the ACM Special Interest Group on Data Communication (SIGCOMM, acceptance rate 18%), Budapest, Hungary, pp. 490–503.
- P. Kumar, Y. Yuan, C. Yu, N. Foster, R. Kleinberg, P. Lapukhov, C. L. Lim, and R. Soulé. Semi-Oblivious Traffic Engineering: The Road Not Taken. April 2018. USENIX Symposium on Networked Systems Design and Implementation (NSDI, acceptance rate 15%), Renton, WA, pp. 157–170.
- X. Jin, X. Li, H. Zhang, N. Foster, J. Lee, R. Soulé, C. Kim, and I. Stoica. NetChain: Scale-Free Sub-RTT Coordination. April 2018. USENIX Symposium on Networked Systems Design and Implementation (NSDI, acceptance rate 15%), Renton, WA, pp. 35–49.
- T. Jepsen, M. Moshref, A. Carzaniga, N. Foster, and R. Soulé. Life in the Fast Lane: A Line-Rate Linear Road. March 2018. ACM SIGCOMM Symposium on Software-Defined Networking Research (SOSR, acceptance rate 29%), Los Angeles, CA, paper 10.
- P. Kumar, C. Yu, Y. Yuan, N. Foster, R. Kleinberg, and R. Soulé. YATES: Rapid Prototyping for Traffic Engineering Systems. March 2018. ACM SIGCOMM Symposium on Software-Defined Networking Research (SOSR, acceptance rate 29%), Los Angeles, CA, paper 11.
- X. Jin, X. Li, H. Zhang, R. Soulé, J. Lee, N. Foster, C. Kim, I. Stoica. NetCache: Balancing Key-Value Stores with Fast In-Network Caching. October 2017. ACM SIGOPS Symposium on Operating Systems Principles (SOSP, acceptance rate 17%), Shanghai, China, pp. 121–136.
- S. Basu, N. Foster, H. Hojjat, P. Palacharla, C. Skalka, and X. Wang. Life on the Edge: Unraveling Policies into Configurations. May 2017. IEEE/ACM Symposium on Architectures for Networking and Communications Systems (ANCS, acceptance rate 27%), Beijing, China, pp. 178–190.

- H. Wang, R. Soulé, H. T. Dang, K. S. Lee, V. Shrivastav, N. Foster, and H. Weatherspoon. P4FPGA: A Rapid Prototyping Framework for P4. April 2017. ACM SIGCOMM Symposium on Software-Defined Networking Research (SOSR, acceptance rate 23%), Santa Clara, CA, pp. 122–135.
- S. Smolka, P. Kumar, N. Foster, D. Kozen, and A. Silva. Cantor Meets Scott: Semantic Foundations for Probabilistic Networks. January 2017. ACM SIGACT–SIGPLAN Symposium on Principles of Programming Languages (POPL, acceptance rate 22%), Paris, France, pp. 557–571.
- J. DiLorenzo, R. Zhang, E. Menzies, K. Fisher, and N. Foster. Incremental Forest: A DSL for Efficiently Managing Filestores. November 2016. ACM SIGPLAN Conference on Object-Oriented Programming Languages, Systems, and Applications (OOPSLA, acceptance rate 26%), Amsterdam, Netherlands, pp. 252–271.
- H. Hojjat, P. Ruegger, J. McClurg, P. Cerny, and N. Foster. Optimizing Horn Solvers for Network Repair. October 2016. Formal Methods in Computer-Aided Design (FMCAD), Mountain View, CA, pp. 73–80.
- P. Cerny, N. Foster, N. Jagnik, and J. McClurg. Optimal Consistent Network Updates in Polynomial Time. September 2016. International Symposium on Distributed Computing (DISC), Paris, France, pp. 114–128.
- J. McClurg, H. Hojjat, N. Foster, and P. Cerny. Event-Driven Network Programming. June 2016. ACM SIGPLAN Conference on Programming Language Design and Implementation (PLDI, acceptance rate 27%), Santa Barbara, CA, pp. 369–385.
- N. Foster, D. Kozen, K. Mamouras, M. Reitblatt, and A. Silva. Probabilistic NetKAT. April 2016. European Symposium on Programming (ESOP, acceptance rate 33%), Eindhoven, Netherlands, pp. 282–309.
- H. Chen, N. Foster, J. Silverman, M. Whittaker, B. Zhang, and R. Zhang. Felix: Implementing Traffic Measurement on End Hosts Using Program Analysis. March 2016. ACM SIGCOMM Symposium on Software-Defined Networking Research (SOSR, acceptance rate 25%), Santa Clara, CA, paper 14.
- K. Saur, J. Collard, N. Foster, A. Guha, L. Vanbever, and M. Hicks. Safe and Flexible Controller Upgrades for SDNs. March 2016. ACM SIGCOMM Symposium on Software-Defined Networking Research (SOSR, acceptance rate 25%), Santa Clara, CA, paper 8.
- S. Smolka, S. A. Eliopoulos, N. Foster, and A. Guha. A Fast Compiler for NetKAT. August 2015. ACM SIGPLAN International Conference on Functional Programming (ICFP, acceptance rate 29%), Vancouver, BC, pp. 328–341.
- J. McClurg, H. Hojjat, P. Cerny, and N. Foster. Efficient Synthesis of Network Updates. June 2015. ACM SIGPLAN Conference on Programming Language Design and Implementation (PLDI, acceptance rate 19%), Portland, OR, pp. 196–207.
- S. Roy, L. Kot, G. Bender, B. Ding, H. Hojjat, C. Koch, N. Foster, and J. Gehrke. The Homeostasis Protocol: Avoiding Transaction Coordination Through Program Analysis. May 2015. ACM SIGMOD Conference on Management of Data (SIGMOD, acceptance rate 26%), Melbourne, Australia, pp. 1311–1326.
- N. Foster, D. Kozen, M. Milano, A. Silva, and L. Thompson. A Coalgebraic Decision Procedure for NetKAT. January 2015. ACM SIGPLAN-SIGACT Symposium on Principles of Programming Languages (POPL, acceptance rate 23%), Mumbai, India, pp. 343–355.
- R. Soulé, S. Basu, P. J. Marandi, F. Pedone, R. Kleinberg, E.G. Sirer, and N. Foster. Merlin: A Language for Provisioning Network Resources. December 2014. ACM SIGCOMM Conference on emerging Networking Experiments and Technologies (CONEXT, acceptance rate 20%), Sydney, Australia, pp. 213–226.

- L. Princehouse, R. Chenchu, Z. Jiang, K. P. Birman, N. Foster, and R. Soulé. MiCA: A Compositional Architecture for Gossip Protocols. July 2014. European Conference on Object-Oriented Programming (ECOOP, acceptance rate 27%), Uppsala, Sweden, pp. 644–669.
- C. Anderson, N. Foster, A. Guha, J. B. Jeannin, D. Kozen, C. Schlesinger, and D. Walker. NetKAT: Semantic Foundations for Networks. January 2014. ACM SIGACT-SIGPLAN Symposium on Principles of Programming Languages (POPL, acceptance rate 23%), San Diego, CA, pp. 113–126.
- A. Guha, M. Reitblatt, and N. Foster. Machine-Verified Network Controllers. June 2013. ACM SIGPLAN Conference on Programming Language Design and Implementation (PLDI, acceptance rate 17%), Seattle, WA, pp. 483–494.
- C. Monsanto, J. Reich, N. Foster, J. Rexford, and D. Walker. Composing Software-Defined Networks. April 2013. USENIX Symposium on Networked Systems Design and Implementation (NSDI, acceptance rate 22%), Lombard, IL, pp. 1–13.
- M. Reitblatt, N. Foster, J. Rexford, C. Schlesinger, and D. Walker. Abstractions for Network Update. August 2012. ACM SIGCOMM Conference on Applications, Technologies, Architectures, and Protocols for Computer Communications (SIGCOMM, acceptance rate 13%), Helsinki, Finland, pp. 323–334.
- C. Monsanto, N. Foster, R. Harrison, and D. Walker. A Compiler and Run-time System for Network Programming Languages. January 2012. ACM SIGACT-SIGPLAN Symposium on Principles of Programming Languages (POPL, acceptance rate 21%), Philadelphia, PA, pp. 217–230.
- N. Foster, R. Harrison, C. Monsanto, M. J. Freedman, J. Rexford, and D. Walker. Frenetic: A Network Programming Language. September 2011. ACM SIGPLAN International Conference on Functional Programming (ICFP, acceptance rate 34%), Tokyo, Japan, pp. 279–291.
- K. Fisher, N. Foster, D. Walker, and K. Q. Zhu. Forest: A Language and Toolkit for Programming with Filestores. September 2011. ACM SIGPLAN International Conference on Functional Programming (ICFP, acceptance rate 34%), Tokyo, Japan, pp. 292–306.
- Barbosa, D. M. J., Cretin, J., Foster N., Pierce, B. C., Greenberg, M. Matching Lenses: Alignment and View Update. September 2010. ACM SIGPLAN International Conference on Functional Programming (ICFP, acceptance rate 34%), Baltimore, MD, pp. 193–204.
- Foster, J. N., B. C. Pierce, and S. Zdancewic. Updatable Security Views. July 2009. IEEE Computer Security Foundations Symposium (CSF, acceptance rate 24%), Port Jefferson, NY, pp. 60–74.
- Foster, J. N., A. Pilkiewicz, and B. C. Pierce. Quotient Lenses. September 2008. ACM SIGPLAN International Conference on Functional Programming (ICFP, acceptance rate 29%), Victoria, BC, pp. 383–395.
- Foster, J. N., T. J. Green, and V. Tannen. Annotated XML: Queries and Provenance. June 2008. ACM SIGMOD Symposium on Principles of Database Systems (PODS, acceptance rate 18%), Vancouver, BC, pp. 271–280.
- Bohannon, A., J. N. Foster, B. C. Pierce, A. Pilkiewicz, and A. Schmitt. Boomerang: Resourceful Lenses for String Data. January 2008. ACM SIGACT-SIGPLAN Symposium on Principles of Programming Languages (POPL, acceptance rate 17%), San Francisco, CA, pp. 407–419.
- Fernandez, M., K. Fisher, J. N. Foster, M. Greenberg, and Y. Mandelbaum. A Generic Programming Toolkit for PADS/ML: First-Class Upgrades for Third-Party Developers. January 2008. International Symposium on Practical Aspects of Declarative Languages (PADL, acceptance rate 44%), San Francisco, CA, pp. 133–149.
- Aydemir, B. E., A. Bohannon, M. Fairbairn, J. N. Foster, B. C. Pierce, P. Sewell, D. Vytiniotis, G. Washburn, S. Weirich, and S. Zdancewic. Mechanized Metatheory for the Masses: The POPLMark Challenge. August 2005. International Conference on Theorem Proving in Higher Order Logics (TPHOLs, acceptance rate 49%), Oxford, UK, pp. 50–65.

- Foster, J. N., M. B. Greenwald, C. Kirkegaard, B. C. Pierce, and A. Schmitt. Exploiting Schemas in Data Synchronization. August 2005. Symposium on Database Programming Languages (DBPL, acceptance rate 27%), Trondheim, Norway, pp. 42–57.
- Foster, J. N., M. B. Greenwald, J. T. Moore, B. C. Pierce, and A. Schmitt. Combinators for Bi-Directional Tree Transformations: A Linguistic Approach to the View Update Problem. January 2005. ACM SIGACT–SIGPLAN Symposium on Principles of Programming Languages (POPL, acceptance rate 18%), Long Beach, CA, pp. 233–246.
- Bruce, K. B. and J. N. Foster. LOOJ: Weaving LOOM into Java. June 2004. European Conference on Object-Oriented Programming (ECOOP, acceptance rate 19%), Oslo, Norway, pp. 389–413.

Workshop Papers

- A. Myers, B. Nigito, N. Foster. Network Design Considerations for Trading Systems. November 2024. ACM SIGCOMM Workshop on Hot Topics in Networks (HotNets, acceptance rate 28%), Irvine, CA, pp. 282–289.
- S. Basu, A. Mohan, J. Grimmelmann, N. Foster. Legal Calculi. January 2022. In Workshop on Programming Languages and the Law (ProLaLa, acceptance rate 68%).
- S. Basu, A. Mohan, J. Grimmelmann, N. Foster. Littleton: An Educational Environment for Property Law. January 2022. In Workshop on Programming Languages and the Law (ProLaLa, acceptance rate 68%).
- E. Bagdasaryan, G. Berlstein, J. Waterman, E. Birrell, N. Foster, F. B. Schneider, D. Estrin. Ancile: Enhancing Privacy for Ubiquitous Computing with Use-Based Privacy. ACM Workshop on Privacy in the Electronic Society (WPES), London, UK, pp. 111–124.
- T. Jepsen, M. Moshref, A. Carzaniga, N. Foster, R. Soulé. Packet Subscriptions for Programmable ASICs. November 2018. ACM SIGCOMM Workshop on Hot Topics in Networks (HotNets), Redmond, WA, pp. 176–183.
- R. Soulé, S. Basu, R. Kleinberg, E. G. Sirer, and N. Foster. Managing the Network with Merlin. November 2013. ACM SIGCOMM Workshop on Hot Topics in Networks (HotNets), College Park, MD.
- L. Vanbever, J. Reich, T. Benson, N. Foster, and J. Rexford. HotSwap: Correct and Efficient Controller Upgrades for Software-Defined Networks. August 2013. ACM SIGCOMM Workshop on Hot topics in Software Defined Networking (HotSDN), Hong Kong, China, pp. 133–138.
- M. Reitblatt, M. Canini, A. Guha, and N. Foster. FatTire: Declarative Fault Tolerance for Software-Defined Networks. August 2013. ACM SIGCOMM Workshop on Hot Topics in Software Defined Networking (HotSDN), Hong Kong, China, pp. 109–114.
- A. Guha, M. Reitblatt, N. Foster. Formal Foundations for Software-Defined Networks. April 2013. Open Networking Summit Research Track (ONS). San Jose, CA.
- R. Rajkumar, S. Lindley, N. Foster and J. Cheney. Lenses for Web Data. March 2013. International Workshop on Bidirectional Transformations (BX), Rome, Italy.
- S. Gutz, A. Story, C. Schlesinger, and N. Foster. Splendid Isolation: A Slice Abstraction for Software Defined Networks. August 2012. ACM SIGCOMM Workshop on Hot Topics in Software-Defined Networking (HotSDN), Helsinki, Finland, pp. 79–84.
- M. Reitblatt, N. Foster, J. Rexford, and D. Walker. Consistent Updates for Software-Defined Networks: Change You Can Believe In! November 2011. ACM SIGCOMM Workshop on Hot Topics in Networking (HotNets), Cambridge, MA.

- N. Foster, R. Harrison, M. Meola, M. Freedman, J. Rexford, D. Walker. Frenetic: A High-Level Language for OpenFlow Networks. November 2010. ACM SIGCOMM Workshop on Programmable Routers for Extensible Services of Tomorrow (PRESTO), Philadelphia, PA.
- Cheney, J., Chong S., Foster, N., Seltzer, M., and Vansummeren, S. Provenance: A Future History. October 2009. Onward! an OOPSLA conference, Orlando, FL. pp. 957-964.
- Foster, J. N., Konuru, R., Simeon, J., Villard, L., An Algebraic Approach to XQuery View Maintenance. January 2008. ACM SIGPLAN Workshop on Programming Language Technologies for XML (PLAN-X), San Francisco, CA.
- Foster, J. N., B. C. Pierce, and A. Schmitt. A Logic Your Typechecker Can Count On: Unordered Tree Types in Practice. January 2007. ACM SIGPLAN Workshop on Programming Language Technologies for XML (PLAN-X), Nice, France, pp. 80–90.

Other Publications

- N. Foster, N. McKeown, J. Rexford, G. M. Parulkar, L. L. Peterson, O. Sunay. October 2020. Using Deep Programmability to Put Network Owners in Control. ACM SIGCOMM Computer Communications Review (CCR). 50(4): 82-88.
- G. Antichi, T. Benson, N. Foster, F. M. V. Ramos, J. Sherry. Programmable Network Data Planes (Dagstuhl Seminar 19141). March 2019. Dagstuhl Reports 9(3): 178–201.
- N. Bjorner, N. Foster, P. B. Godfrey, P. Zave. Formal Foundations for Networking (Dagstuhl Seminar 15071). February 2015. Dagstuhl Reports, 5(2):44–63.
- Foster, J. N. and Karvounarakis G. Provenance and Data Synchronization. December 2007. IEEE Data Engineering Bulletin Special Issue on Provenance, 30(4):13–21.
- Foster, J. N. and D. Vytiniotis. A Theory of Featherweight Java in Isabelle/HOL. April 2006. Archive of Formal Proofs.

Tutorials

- N. Foster, F. Ruffy, R. Sherwood, J. DiLorenzo. Designing Networks for Testing. August 2023. ACM SIGCOMM Conference.
- N. Foster. Introduction to Network Verification. August 2021. ACM SIGCOMM Conference.
- N. Foster. Petr4: Formal Foundations for P4 Data Planes. June 2021. Computer Aided Verification (CAV).
- N. Foster and C. Kim. P4: Programming the Network Data Plane. August 2017. ACM SIGCOMM Conference, Los Angeles, CA.
- N. Foster, A. Guha, S. Eliopoulos. Open Network Programming. October 2014. Open Networking Users Group (ONUG), New York, NY.
- N. Foster, A. Guha, V. Yang. Network Programming in Frenetic. August 2014. European Conference on Object-Oriented Programming (ECOOP) Summer School, Uppsala, Sweden.
- N. Foster, A. Guha, M. Reitblatt, C. Schlesinger. Network Programming in Frenetic. October 2013. Formal Methods in Computer-Aided Design (FMCAD), Portland, OR.
- N. Foster, A. Guha, M. Reitblatt, C. Schlesinger. Network Programming in Frenetic. June 2013. Symposium on Programming Languages Design and Implementation (PLDI), Seattle, WA.

Presentations

- *Specifying and Verifying Network Behavior with NetKAT*
Isaac Newton Institute Workshop on Big Specification, October 2024
- *Proof-Carrying Network Code: An Idea Whose Time Has Come*
LFCS Seminar, University of Edinburgh, June 2024
Invited Talk, ETH Zürich, May 2024
- *The Network is the Computer: A Programming Languages Perspective*
Distinguished Lecture, Northwestern University, October 2024
Invited talk, ETH Zürich, January 2024
Keynote, ACM SIGPLAN POPL, January 2024
IC Seminar, École Polytechnique Fédérale de Lausanne, January 2024
- *Deep Programmability: A New Lens on Networking*
Keynote, Cornell CSL Retreat, May 2023
Keynote, ACM SIGPLAN ICFP, September 2022
- *Runtime Network Verification*
Google Networking Faculty Summit, February 2022
- *Neptune: Heterogeneous Packet-Processing Architectures*
IBM Network Programming Workshop, October 2022
- *Pronto: Verifiable, Closed-Loop Control of 5G Networks*
CIDA Seminar, August 2021
Microsoft Azure for Operators, August 2021
- *eBPF and P4: Better Together*
eBPF Summit, August 2021
- *Tradeoffs in Programmable Data Planes Flexibility vs. Performance*
Network Architecture Geeks (NAG), June 2021
- *Toward Verified Data Planes*
UCSD Database Seminar, February 2022
Keynote, ACM SIGCOMM SOSR, October 2022
Isaac Newton Institute Workshop on Verified Software: Tools and Experiments, June 2021
- *From Programmable Switches to Programmable Networks*
Keynote, P4 Workshop, May 2021
- *Synthesizing Network Configuration Updates*
Simons Institute Workshop on Synthesis of Models and Systems, May 2021
- *Verifiable Networks*
Open Networking Foundation Spotlight Series, November 2020
- *Petr4: Formal Foundations for P4 Data Planes*
University of Pennsylvania, Programming Languages Club, October 2020
Invited talk, Workshop on Formal Foundation of SDN (FoFoSDN), November 2020
- *Trustworthy Network Programming*
Open Networking Conference, Bengaluru, India, July 2019
- *Guarded Kleene Algebra with Tests*
IFIP WG 2.8, Bordeaux, France, May 2019
- *Type Safe Data Plane Programming: How to Avoid Making a Billion Dollar Mistake*
Cisco SDN / P4 Faculty Summit, May 2019

- *Abstractions for Network Programming*
Keynote, ACM SIGCOMM CoNEXT, December 2018
- *Network Verification: Successes and Opportunities*
Invited talk, ACM SIGSAC PLAS Workshop, October 2018
- *Verifying Network Data Planes*
CS Colloquium, University of Illinois at Chicago, September 2020
IFIP WG 2.8, Asilomar, June 2018
Stanford Software Lunch, June 2018
CS Colloquium, Colgate University, January 2018
Invited talk, SPLASH '17, Vancouver, WA, October 2017
Jane Street Tech Talk, New York, NY, October 2017
ETH Workshop on Software Correctness and Reliability, Zurich, Switzerland, October 2017
- *High-Level Abstractions for Programmable Networks*
Fujitsu Labs, Tokyo, Japan, March 2018
- *Automated Verification of P4 Programs*
Google, Sunnyvale, CA, June 2017
- *When McKeown Meets Milner: Semantic Foundations for Network Programming*
Google Platforms Team, January 2017.
- *Cantor Meets Scott: Semantic Foundations for Probabilistic Networks.*
PLSE Seminar, University of Washington, Seattle, WA, November 2016.
- *Software Synthesis for Networks*
Networking Seminar, Stanford University, Stanford, CA, December 2016.
- *Incremental Forest: A DSL for Efficiently Managing Filestores*
ACM SIGPLAN RDP Workshop, Paris, France, January 2017.
ACM SIGPLAN OOPSLA Conference, Amsterdam, Netherlands, October 2016.
IFIP WG 2.8, Lake Placid, NY, July 2016.
- *The Next 700 Network Programming Languages*
Invited Talk, ACM SIGCOMM NetPL Workshop, August 2016.
Invited talk, LOLA Workshop, July 2016.
Cisco Faculty Summit, Invited talk, May 2016.
- *Probabilistic NetKAT*
New Jersey Programming Languages Seminar, May 2016.
- *Kulfi: Robust Traffic Engineering Using Semi-Oblivious Routing*
NSF AiTF Workshop on Algorithms for Software-Defined Networking, May 2016.
- *NetKAT: Semantic Foundations for Networks*
MIT CSAIL, Programming Languages Seminar, October 2015
Stanford University, Software Systems Seminar, September 2015
- *Specifying and Verifying Network Behavior with NetKAT*
Tufts University, Computer Science Colloquium, October 2015
- *Keep Calm and Carry On: Near Optimal Traffic Engineering with Modest State Changes*
AT&T Labs, August 2015
- *A Language-Based Approach to Network Verification and Synthesis*
Microsoft Research Faculty Summit, Invited talk, July 2015
- *Transactional Forest: Strong Consistency for File Stores*
IFIP Working Group 2.8, Functional Programming, May 2015

- *A Fast Compiler for NetKAT*
COPLAS Seminar, University of Copenhagen, March 2015
- *You and Your Graduate Research*
ACM SIGPLAN Programming Languages Mentoring Workshop (PLMW), January 2015
- *Network Updates for the Impatient: Eliminating Unnecessary Waits*
Workshop on Programming Languages and Verification Technology for Networking, January 2015
ACM SIGPLAN Programming Languages Mentoring Workshop, January 2015
- *The Homeostasis Protocol*
Dagstuhl Seminar on Programming Languages for Big Data, December 2014
- *A Coalgebraic Decision Procedure for NetKAT*
IFIP WG 2.8, August 2014
- *SDN Foundations*
Keynote, PODC Workshop on Distributed Software-Defined Networking, July 2014
- *Network Programming with Frenetic*
IAP Cornell Workshop, October 2015
Carnegie Mellon University, Principles of Programming (POP) Seminar, May 2015
Cornell CS ACSU, February 2015
HP Labs, April 2014
LogicBlox, April 2014
Cisco, April 2014
Rice Computer Science Colloquium, March 2014
- *Formal Foundations for Networks*
Microsoft Research RiSE group, April 2013
- *Machine-Verified Network Controllers*
USC CS Colloquium, December 2012
Pomona CS Colloquium, December 2012
UCLA Programming Languages Seminar, December 2012
IFIP Working Group 2.8—Functional Programming, November 2012
- *Consistent Updates in Software-Defined Networks*
Open Networking Summit, April 2012.
- *Abstractions for Network Update*
IFIP Working Group 2.8—Functional Programming, February 2012.
- *Language Abstractions for Software-Defined Networks*
Dagstuhl Seminar on Software-Defined Networks, September 2012.
University of Washington, July 2012.
Microsoft Research Networking Summit, July 2012.
Workshop on Language Abstractions for Distributed Algorithms (LADA), January 2012.
- *Frenetic: A Network Programming Language*
Galois Corporation, December 2011.
Intel Corporation, December 2011.
Eastern Great Lakes Systems and Networking Workshop, August 2011.
- *Languages for Bidirectional Transformations*
Schloss Dagstuhl, January 2011.
- *Frenetic: Functional Reactive Programming for Networks*
IBM Research Programming Languages Day, August 2010.
- *Matching Lenses: Alignment and View Update*
Williams College, April 2010.

- *Bidirectional Programming*
Spring School on Generic and Indexed Programming, March 2010.
- *Bidirectional Programming Languages*
University of Waterloo, March 2009.
University of Edinburgh, March 2009.
Worcester Polytechnic Institute, March 2009.
New York University, April 2009.
Cornell University, April 2009.
University of Oregon, April 2009.
Georgia Institute of Technology, December 2009.
- *Updatable Security Views*
Computer Security Foundations Symposium (CSF), July 2009.
IBM Research Programming Languages Day, May 2009.
- *Quotient Lenses*
International Conference on Functional Programming (ICFP), September 2008.
IBM Research Programming Languages Day, August 2008.
- *Boomerang: Resourceful Lenses for String Data*
Symposium on Principles of Programming Languages (POPL), January 2008.
New Jersey Programming Languages Seminar (NJPLS), November 2007.
Workshop on Principles of Provenance (PrOPr), June 2007.
- *A Logic Your Typechecker Can Count On: Unordered Tree Types in Practice*
Workshop on Programming Language Technologies for XML (PLAN-X), January 2007.
New Jersey Programming Languages Seminar (NJPLS), February 2007.
- *Exploiting Schemas in Data Synchronization*
New England Programming Languages Seminar (NEPLS), June 2005.
August on Database Programming Languages (DBPL), September 2005.
- *Combinators for Bidirectional Tree Transformations: A Linguistic Approach to the View Update Problem*
Symposium on Principles of Programming Languages (POPL), January 2005.
- *LOOJ: Weaving LOOM into Java*
European Conference on Object Oriented Programming (ECOOP), June 2004.
- *Rupiah: Towards an Expressive Static Type System for Java*
Mid-Atlantic Student Workshop on Programming Languages and Systems (MAPLAS), April 2001.
New England Programming Languages Seminar (NEPLS), May 2001.

Teaching

- CS 2110, "Object-Oriented Programming and Data Structures," Fall 2015
- CS 2112, "Object-Oriented Programming and Data Structures (Honors)," Fall 2022
- CS 3110, "Data Structures and Functional Programming," Spring 2012, Spring 2014, Spring 2018, Spring 2020, Spring 2022
- CS 4110, "Programming Languages and Logics," Fall 2010, Fall 2012, Fall 2014, Fall 2020
- CS 5114, "Network Programming Languages," Spring 2013, Fall 2017, Fall 2018, Fall 2019, Spring 2021, Fall 2021
- CS 6112, "Foundations of Concurrency," Fall 2011
- CS 6110, "Advanced Programming Languages," Spring 2011, Spring 2016
- CS 6115, "Certified Software Systems," Spring 2015, Spring 2023, Fall 2024

- CS 7190, “Seminar in Programming Languages,” Fall 2010–Spring 2016
- CS 7194, “Great Works in Programming Languages,” Spring 2019

Advising

- **Graduate Field Memberships**

Computer Science, 2010–present

Electrical and Computer Engineering, 2020–present

Information Science, 2021–present

- **Postdoctoral Research Associates**

Guy Amir, 2024–present

Jules Jacobs, 2023–present

Parisa Ataei, 2021–2023

Employment: Software Engineer, IOG

Mina Tahmasbi Arashloo, 2019–2022

Employment: Assistant Professor, University of Waterloo

Tobias Kappé, 2020–2021

Employment: Assistant Professor, University of Leiden

Hardik Soni, 2018–2020

Employment: Research Staff, NEC Labs, Europe

Justin Hsu, 2018

Employment: Associate Professor, Cornell University

Hossein Hojjat, 2014–2016

Employment: Assistant Professor, University of Tehran

Hugo Pacheco, 2014–2015

Employment: Assistant Professor, University of Porto

Robert Soulé, 2012–2013

Employment: Assistant Professor, Yale University

Arjun Guha, 2012–2013

Employment: Associate Professor, Northeastern University

- **PhD Students**

Emmanuel Suarez Acevedo, 2024–present

Mark Barbone, 2024–present

Ernest Ng, 2024–present

Mark Moeller, 2020–present

Passed A-exam: May 2023

Eric Campbell, 2018–2024

PhD thesis: *Verified Configuration of Programmable Networks*

NSF Graduate Research Fellowship

Currently employment: Postdoctoral researcher, University of Texas at Austin

Ryan Doenges, 2018–2023

PhD thesis: *Programming Language Foundations for Packet Processing*

Employment: Distinguished Postdoctoral Fellow, Northeastern University

Praveen Kumar, 2014–2021

PhD thesis: *Toward Predictable Networks*

Winner of 2021 ACM SIGCOMM Dissertation Award

Employment: Software engineer, Google Research

Jonathan DiLorenzo, 2013–2020

PhD thesis: *Domain-Specific Languages for Ad Hoc Data Processing*

Employment: Software engineer, Google

Steffen Smolka, 2014–2019

PhD thesis: *A (Co)Algebraic Approach to Programming and Verifying Computer Networks*

Employment: Staff Software engineer, Google

Shrutarshi Basu, 2011–2018

PhD thesis: *Languages for Path-Based Network Programming*

Employment: Visiting Assistant Professor, Middlebury College

Mark Reitblatt, 2010–2015

PhD thesis: *Formal Reasoning in Software-Defined Networks*

Employment: Software engineer, Meta

- **MS / MEng Research Students**

Tia Vu, '24

Hussan Mohammad Ahmad '23

Yunhe Liu, '22

Samwise Parkinson '22

Andy Chu '21

Hyun Kyo Jung '20

Sheethal Athrey, '20

Jill Wu '19

Dheeraj Chakilam '19

Rakesh Devendernath '18

Matthew Habel '18

Dhruv Singhal '17

Christopher Anderson '16

Bryan Cuccioli '14

Norris Xu '12

- **Undergraduate Research Students**

Benny Rubin '24

Honorable mention, CRA Outstanding Undergraduate Researcher Awards, 2023

Megan Jung '23

Honorable mention, CRA Outstanding Undergraduate Researcher Awards, 2022

Nigusu Yenework '23

Natalie Isak '22

Calvin Shyu '22

Pierce Douglis '22

Melissa Ginaldo '22

Alaia Solko Breslin '22

Priya Srikumar '21

Alexander Chang '21

Rudy Peterson '20

Samwise Parkinson '20

Amanda Xu '20
Caleb Koch '20
Santiago Bautista, ENS Rennes '19
Avaljot Singh, IIT Delhi '19
Jialu Bao '19
Newton Ni '19
Tony Zhang '19
Siva Somayyajula '18
Justin Namba, RIT '18
Eric Perdew '17
Sushmitha Krishnamoorthy '17
Jake Silverman '17
Anna Yesypenko '17
Michael Whittaker '16
Brandon Zhang '16
Rene Zhang '16
Richard Zhang '16
Andrew DeMaio '15
Jung Hyun Eun '15
Yiming Wu '15
Chris Yu '15

Honorable mention, CRA Outstanding Undergraduate Researcher Awards, 2015

Carolyn Anderson, Swarthmore '14

Finalist, CRA Outstanding Undergraduate Researcher Awards, 2014

Rebecca Coombes '14

Toshi Noguchi '14

Andrew Noyes '14

Honorable mention, CRA Outstanding Undergraduate Researcher Awards, 2014

Matthew Oey '14

Todd Warszawski '14

Satvik Chauhan, IIT Kanpur '13

Costantino Moraites '13

Seth Pree '13

Alec Story '12

Honorable mention, CRA Outstanding Undergraduate Researcher Awards, 2012

Stephen Gutz '12

Kevin Ullmann '12

Lucas Waye '11

- **Special Committee Member**

Keri D'Angelo

Passed A-exam, October 2024

Rachit Nigam PhD thesis: *Modular Abstractions for Efficient Hardware Design*

Passed B-exam, October 2024

Xiang Long

PhD thesis: *Primitives for Match-Action in Theory and Practice*

Passed B-exam, May 2021

Mae Milano

PhD thesis: *Abstractions for Combining Weak and Strong Consistency*

Passed B-exam, July 2020

Vishal Shrivastav

PhD thesis: *Towards High-speed Networking in the Post-Moore Era*

Passed B-exam, July 2020

Lonnie Princehouse

PhD thesis: *Compositional Gossip Systems*

Passed B-exam, May 2017

Ki Suh Lee

PhD thesis: *Toward Precise Network Measurements*

Passed B-exam, November 2016

Zhiyuan Teo

PhD thesis: *Overcoming Challenges In Practical SDN Deployment*

Passed B-exam, July 2016

Bailu Ding

PhD thesis: *Optimizing Optimistic Concurrency Control*

Passed B-exam, April 2016

Haoyan Geng

PhD thesis: *Towards Efficient and Reliable Pub/Sub for Geo-Distributed Datacenters*

Passed B-exam, August 2015

Robert Surton

PhD thesis: *Channel market analysis of the Transmission Control Protocol*

Passed B-exam, January 2014

Jean-Baptiste Jeannin

PhD thesis: *Capsules and Non-Well-Founded Computation*

Passed B-exam, June 2013

Oliver Kennedy

PhD thesis: *Watch out for... What?!?: Monitoring and Uncertainty in Scientific Computing*

Passed B-exam, April 2011

- **External PhD Committee Member**

Dragos Dumitrescu, Politehnica University of Bucharest, June 2022

PhD thesis: *Verification of Programmable Networks*

Robert Harrison, Princeton University, February 2019

PhD thesis: *Scalable Network-Wide Telemetry with Programmable Switches*

Jedidiah McClurg, University of Colorado at Boulder, July 2017

PhD thesis: *Program Synthesis for Software-Defined Networking*

Niels Bjørn Bugge Grathwohl, University of Copenhagen, November 2015

PhD thesis: *Parsing with Regular Expressions and Extensions to Kleene Algebra*

Hyojoon Kim, Georgia Institute of Technology, May 2015

PhD thesis: *Facilitating Dynamic Network Control with Software-Defined Networking*

Daniel Wagner, University of Pennsylvania, June 2014

PhD thesis: *Symmetric Edit Lenses: A New Foundation for Bidirectional Languages*

Funding

- *Verification and Synthesis of Network Control Interfaces* (PI)
VMware University Research Fund, Gift, \$350,000, 2024–2025.
- *5STARS: 5G SDN Tools for Automated and Reliable Security* (PI)
Office of Naval Research, \$1,482,937, 2022–2028.
- *LANCER: LeArning Network CybERagents* (PI)
DARPA Information Innovation Office (I2O), \$2,961,831, 2023–2026.
- *Pronto-2* (PI)
DARPA Information Innovation Office (I2O), \$148,151, 2024–2025.
- Juniper Networks, Gift, \$150,000, 2022–2025.
- *Securing our National Internet Infrastructure: Using Measurement, Control, and Verification for Closed-loop Control of Networks* (PI)
DARPA Information Innovation Office (I2O), \$2,377,728, 2020–2023.
- *Formal Reasoning for Legal Conveyances* (PI)
National Science Foundation, \$99,998, 2020–2022.
- *Petr4: Formal Foundations for Programmable Networks* (PI)
National Science Foundation, \$749,995, 2019–2023.
- *Enterprise ProNet* (PI)
DARPA Information Innovation Office (I2O), Dispersed Computing, \$484,500, 2018–2021.
- Fujitsu, Gift, \$50,000, 2020–2021.
- *Formal Semantics for P4* (PI)
Keysight Corporation, \$50,000, 2018–2019.
- Infosys, Gift, \$300,000, 2018–2020.
- *A New Approach to Federated Network Security* (PI)
National Science Foundation, \$131,691, 2017–2020.
- *Campus Infrastructure for Microscale, Privacy-Conscious, Data-Driven Planning* (PI)
National Science Foundation, \$999,364, 2017–2018.
- *Theory and Practice of Probabilistic Network Programming* (PI)
National Science Foundation, \$799,000, 2016–2020.
- *HeisenKAT: A Probabilistic Network Programming Language* (PI)
Google Research Award, \$69,211, 2015.
- Facebook, Gift, \$60,000, 2015–2016.
- Fujitsu, Gift, \$100,000, 2014–2015.
- *Algorithms and Probabilistic Semantics for Next-Generation Networks* (PI)
National Science Foundation, \$200,000, 2015–2016.
- *Implementing Protocol-Independent Packet Processing with NetKAT and SoNIC* (PI)
Cisco Systems, \$100,000, 2015–2016.
- *A Framework for Programmable Network Management* (Co-PI)
Office of Naval Research, \$1,000,000, 2015–2018.
- *COSciN: Cornell Open Science Network* (PI)
National Science Foundation, \$986,340, 2015–2017.
- *Programmable Inter-Domain Observation and Control* (PI)
National Science Foundation, \$657,163, 2014–2018.
- *Practical Synthesis of Network Updates* (PI)
National Science Foundation, \$249,999, 2014–2017.

- *CAREER: Principles and Practice of Distributed Updates* (PI)
National Science Foundation, \$ 532,005, 2013—2018.
- Yahoo! Labs Career Enhancement Award, \$10,000. 2013.
- *Language and System Support for Managing Updates in Software-Defined Networks* (Co-PI)
Google Research Award, \$33,690, 2012–2013.
- *Networks Opposing Botnets Continuation* (PI)
Office of Naval Research, \$455,600, 2012–2014.
- Alfred P. Sloan Foundation, Research Fellowship, \$50,000. 2012–2014.
- *High Level Language Support for Trustworthy Networks* (PI)
National Science Foundation, \$1,599,999, 2011–2015.
- *A Platform for Building and Composing Secure Federated Systems* (Co-PI)
Office of Naval Research, \$1,633,615, 2009–2012.

Professional Service

- **Vice Chair**
DARPA Information Science and Technology (ISAT) Study Group, 2024–present
<https://isat.ida.org>
- **Program Committee Chair**
ACM SIGCOMM Workshop on Hot Topics in Networking (HotNets), 2024.
<https://https://conferences.sigcomm.org/hotnets/2024>
ACM SIGPLAN Conference on Programming Language Design and Implementation (PLDI), 2023.
<https://pldi23.sigplan.org/>
IEEE Workshop on Theory and Practice of Programmable Forwarding (TaPoPF), 2021.
<https://www.cs.cornell.edu/~jnfoster/tapopf21>
Workshop on Hot Topics in Software-Defined Networks (HotSDN), 2013.
<http://conferences.sigcomm.org/sigcomm/2013/hotsdn.php>
Workshop on Rigorous Protocol Engineering (WRiPE), 2012.
<https://www.cs.cornell.edu/conferences/wripe2012/>
Symposium on Database Programming Languages (DBPL), 2011.
<https://www.cs.cornell.edu/conferences/dbpl2011/>
- **Co-organizer**
Programming Languages Mentoring Workshop (PLMW) ICFP, 2020.
<https://icfp20.sigplan.org/home/PLMW-icfp-2020>
Dagstuhl Seminar 19141 on Programmable Network Data Planes, 2019.
<http://www.dagstuhl.de/en/program/calendar/semhp/?semnr=19141>
NII Shonan Meeting 112 on Theory and Practice of Data Plane Programming, 2018.
shonan.nii.ac.jp/seminar/112/
Workshop on Network Programming Languages, 2018.
<https://popl18.sigplan.org/track/netpl-2018>
Dagstuhl Seminar 15071 on Formal Foundations for Networking, 2015.
<http://www.dagstuhl.de/en/program/calendar/semhp/?semnr=15071>
Cornell Systems-Industry Workshop, 2014.
<http://www.cs.cornell.edu/~jnfoster/systems-industry/>
Cornell Summer School on Formal Methods and Networks, 2013.
<http://www.cs.cornell.edu/Conferences/formalnetworks/>

DIMACS Workshop on Software-Defined Networking, 2012.
<http://dimacs.rutgers.edu/Workshops/SoftwareDefined/>

Programming Languages Mentoring Workshop (PLMW), 2013.
<http://www.doc.ic.ac.uk/~gds/PLMW/>

GRACE Workshop on Bidirectional Transformations, 2008.
<http://grace.gsdlab.org/>

Workshop on Principles of Provenance, 2007.
<http://www.cis.upenn.edu/~plclub/propr/>

- **Member**

Member, IFIP Working Group 2.8, Functional Programming, 2013–present
<https://ifip-wg28.github.io/>

DARPA Information Science and Technology (ISAT) Study Group, 2019–2023
<https://isat.ida.org>

ACM SIGPLAN CARES, 2024–present
<https://www.sigplan.org/Cares/>

ACM SIGCOMM CARES, 2023–present
<https://www.acm.org/volunteers/teams/T402>

- **Steering Committee**

ACM SIGPLAN PLDI, 2021–present.

ACM SIGPLAN POPL Industrial Relations Chair, 2020–2022.

ACM SIGPLAN POPL At-Large Member, 2019–2022.

P4 Language Technical Steering Committee, 2017–2021.

Symposium on Software-Defined Networking Research (SOSR), chair, 2013–2017.

- **Associate Editor**

Communications of the ACM (CACM), 2023–present.

- **Program Committee Member**

OOPSLA '25, SIGCOMM '24, SIGCOMM '21, PLDI '21, ASPLOS '21, NSDI '21, SIGCOMM '20, EuroP4 '20, SPIN '20, PLDI '20, POPL '19, SOSR '19, SOSR '18, SIGCOMM '18, ICFP '18, DSLDI '18, SIGCOMM '17, NSDI '17, POPL '16 (ERC), HotNets '16, ICFP '16, SIGCOMM '16, ANCS '16, APLAS '16 POPL '15 (ERC), APLAS '15, DISC '15, OOPSLA '15, PLDI '15, FM '15, POPL '14, PLDI '14 (ERC), SIGCOMM '14, BX '13, DDFP '13 POPL '12 (ERC), HotSDN '12, RC '12, ICMT '11, WRiPE '11, DSL '11, TaPP '10, PEPM '10, APLAS '09, DBPL '09, PLAN-X '09

- **Reviewer**

Journal of Functional Programming (JFP), Higher-Order and Symbolic Computation (HOSC), Information Systems (IS), Journal of the ACM (JACM), Science of Computer Programming (SCP), Theoretical Computer Science (TCS), Transactions on Programming Languages and Systems (TOPLAS), Transactions on Computer Systems (TOCS)

- **Panelist**

National Science Foundation, 2011, 2013, 2014, 2015, 2017, 2020, 2024.

University Service

- Dean Search Committee, Bowers College of Computing and Information Science, 2024.
- Faculty Advisory Committee, Global Cornell, 2022–present.
- Faculty Recruiting Committee, Department of Computer Science, 2012–2016, 2018–2020, 2022 (chair).
- Teaching Committee, Department of Computer Science, 2020.

- Office of Faculty Diversity and Development Advisory Committee, Cornell University, 2019–2023.
- Cornell Presidential Postdoctoral Fellowship Selection Committee, Cornell University, 2018, 2019.
- Provost’s Task Force on Diversity, Cornell University, 2018.
- Computer Science Chair Search Committee, Cornell University, 2018.
- Ethics Committee, Department of Computer Science, 2015.
- Gates Hall Space Committee, Department of Computer Science, 2014.
- Graduate Admissions Committee, Department of Computer Science, 2011.