STEVEN HOLTZEN

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RESEARCH INTERESTS

My research focuses on programming languages, artificial intelligence, and machine learning. My goal is to design systems that make probabilistic modeling fast, accessible, and useful for solving every-day reasoning tasks. To achieve this I am interested in probabilistic programming languages, foundations of probabilistic inference, tractable probabilistic modeling, automated reasoning, and probabilistic verification.

EDUCATION

University of California, Los Angeles. Ph.D., Computer Science, 2021.

- Dissertation: *Exploiting Program Structure for Scaling Probabilistic Programming.*
- Co-advisors: Guy Van den Broeck and Todd Millstein.

University of California, Los Angeles. M.S., Computer Science, 2017.

University of California, Los Angeles. B.S., Computer Science, 2015.

EMPLOYMENT

Northeastern University — Boston, MA
Assistant Professor, Khoury College of Computer Sciences — Aug. 2021 –

Sandia National Laboratories — Livermore, CA
Member of Technical Staff, department of Cyber Data Analytics. — Sept. 2015 – Aug. 2021

HONORS AND AWARDS

- 2025 – NSF CAREER Award
- 2022 – IEEE MICRO Top Pick Honorable Mention
  For *Logical Abstractions for Noisy Variational Quantum Algorithm Simulation*.
- 2021 – UCLA Computer Science Outstanding Graduating Ph.D. Student.
- 2020 – ACM SIGPLAN Distinguished Paper Award.
  Awarded at OOPSLA for *Scaling Exact Inference for Discrete Probabilistic Programs*.
- (2015–2017) National Physical Sciences Consortium Fellowship

PUBLICATIONS

Conference publications

1. Cameron Moy, Jack Czenszak, John M. Li, Brianna Marshall, and Steven Holtzen. Roulette: A language for expressive, exact, and efficient discrete probabilistic programming. In *ACM SIGPLAN Conference on Programming Language Design and Implementation (PLDI)*, 2025. doi: 10.1145/3729334. URL https://doi.org/10.1145/3729334

2. Sam Stites, John M. Li, and Steven Holtzen. Multi-language probabilistic programming. *Proc. ACM Program. Lang.*, 9(OOPSLA1), April 2025. doi: 10.1145/3720482. URL https://doi.org/10.1145/3720482

3. Minsung Cho, John Gouwar, and Steven Holtzen. Scaling optimization over uncertainty via compilation. *Proc. ACM Program. Lang.*, 9(OOPSLA1), April 2025. doi: 10.1145/3720500. URL https://doi.org/10.1145/3720500

4. John M. Li, Jon Aytac, Philip Johnson-Freyd, Amal Ahmed, and Steven Holtzen. A nominal approach to probabilistic separation logic. In *ACM/IEEE Symposium on Logic in Computer Science (LICS)*, July 2024b

5. Oakley Lisa, Steven Holtzen, and Alina Oprea. Synthesizing tight privacy and accuracy bounds via weighted model counting. In *IEEE Computer Security Foundations Symposium*, 2024

6. Poorva Garg, Steven Holtzen, Guy Van den Broeck, and Todd Millstein. Bit blasting probabilistic programs. *Proc. ACM Program. Lang.*, 8(PLDI), June 2024. doi: 10.1145/3656412. URL https://doi.org/10.1145/3656412

7. Abdelrahman Madkour, , Chris Martens, Steven Holtzen, and Stacy Harteveld, Casper Marsella. Probabilistic logic programming semantics for procedural content generation. In *AAAI Conference on Artificial Intelligence and Interactive Digital Entertainment (AAIDE)*, 2023

8. William X. Cao, Poorva Garg, Ryan Tjoa, Steven Holtzen, Todd Millstein, and Guy Van den Broeck. Scaling integer arithmetic in probabilistic programs. In *Conference on Uncertainty in Artificial Intelligence (UAI)*, July 2023

9. John M. Li, Amal Ahmed, and Steven Holtzen. Lilac: a modal separation logic for conditional probability. In *ACM SIGPLAN Conference on Programming Language Design and Implementation (PLDI)*, June 2023. doi: 10.1145/3591226

10. Steven Holtzen, Sebastian Junges, Marcell Vazquez-Chanlatte, Todd Millstein, Sanjit A. Seshia, and Guy Van den Broeck. Model checking finite-horizon markov chains with probabilistic inference. In *International Conference on Computer-Aided Verification (CAV)*, July 2021. doi: 10.1007/978-3-030-81688-9_27

11. Yipeng Huang, Steven Holtzen, Todd Millstein, Guy Van den Broeck, and Margaret Martonosi. Logical abstractions for noisy variational quantum algorithm simulation. In *International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS)*, 2021

12. Steven Holtzen, Guy Van den Broeck, and Todd Millstein. Scaling exact inference for discrete probabilistic programs. In *Proc. ACM Program. Lang.*, OOPSLA 2020, pages 140:1–140:31. Association for Computing Machinery, 2020c. doi: 10.1145/3428208

13. Honghua Zhang, Steven Holtzen, and Guy Van den Broeck. On the relationship between probabilistic circuits and determinantal point processes. In *Conference on Uncertainty in Aritifical Intelligence (UAI)*, 2020

14. Steven Holtzen, Todd Millstein, and Guy Van den Broeck. Generating and sampling orbits for lifted probabilistic inference. In *Conference on Uncertainty in Artificial Intelligence (UAI)*, 2019b

15. Steven Holtzen, Guy Van den Broeck, and Todd Millstein. Sound abstraction and decomposition of probabilistic programs. In *Proceedings of the 35th International Conference on Machine Learning (ICML)*, July 2018a

16. Steven Holtzen, Todd Millstein, and Guy Van den Broeck. Probabilistic program abstractions. In *Proceedings of the 33rd Conference on Uncertainty in Artificial Intelligence (UAI)*, August 2017b

17. Steven Holtzen, Yibiao Zhao, Tao Gao, Joshua B Tenenbaum, and Song-Chun Zhu. Inferring human intent from video by sampling hierarchical plans. In *2016 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pages 1489–1496. IEEE, 2016

Workshop & non-archival publications

1. Shubh Agrawal, Jialu Bao, and Steven Holtzen. Towards an equational calculus of interventions. In *Workshop on Languages for Inference (LAFI) at POPL*, 2026
2. Jack Czenszak, John M. Li, and Steven Holtzen. Towards symbolic execution for probability and nondeterminism. In *Workshop on Languages for Inference (LAFI) at POPL*, 2025
3. John Li, Jon Aytac, Philip Johnson-Freyd, Amal Ahmed, and Steven Holtzen. Towards a categorical model of the lilac separation logic. In *Workshop on Languages for Inference (LAFI) at POPL*, 2024a
4. John Li, Jon Aytac, Philip Johnson-Freyd, Amal Ahmed, and Steven Holtzen. Towards a categorical model of the lilac separation logic. In *Workshop on Languages for Inference (LAFI) at POPL*, 2024a
5. Sam Stites and Steven Holtzen. A multi-language approach to probabilistic program inference. In *Workshop on Languages for Inference (LAFI) at POPL*, 2024
6. Minsung Cho and Steven Holtzen. Scaling decision-theoretic probabilistic programming through factorization. In *Workshop on Distributions, Relational Algebra, Graphs, Semi-Rings, Tensors, and All That (DRAGSTERS)*, 2023
7. Ellie Cheng, Steven Holtzen, Guy Van den Broeck, and Todd Millstein. flip-hoisting: A probabilistic program optimization for exact inference. In *The International Conference on Probabilistic Programming (PROBPROG)*, 2021
8. Steven Holtzen, Todd Millstein, and Guy Van den Broeck. Modular exact inference for discrete probabilistic programs. In *The International Conference on Probabilistic Programming (PROBPROG)*, 2020a
9. Steven Holtzen, Todd Millstein, and Guy Van den Broeck. Generating and sampling orbits for lifted probabilistic inference. In *International Workshop on Statistical Relational AI (StarAI)*, 2020b
10. Yipeng Huang, Steven Holtzen, Todd Millstein, Guy Van den Broeck, and Margaret Martonosi. Logic formulas as program abstractions for quantum circuits: A case study in noisy variational algorithm simulation. In *International Workshop on Quantum Computing Software at Supercomputing 2020 (WQCS)*, 2020
11. Steven Holtzen, Todd Millstein, and Guy Van den Broeck. Symbolic exact inference for discrete probabilistic programs. In *Workshop on Tractable Probabilistic Modeling (TPM)*, 2019a
12. Steven Holtzen, Joe Qian, Todd Millstein, and Guy Van den Broeck. Factorized exact inference for discrete probabilistic programs. In *Workshop on Languages for Inference at POPL 2019 (LAFI)*, 2019c
13. Steven Holtzen, Guy Van den Broeck, and Todd Millstein. Probabilistic program inference with abstractions. In *Workshop on Probabilistic Programming Languages, Semantics, and Systems at POPL 2018 (PPS)*, 2018b
14. Steven Holtzen, Todd Millstein, and Guy Van den Broeck. Probabilistic program abstractions. In *International Workshop on Statistical Relational AI (StarAI)*, 2017a

GRANTS & FUNDING

External grants & funding

1. *CAREER: Filling In the Design Landscape of Probabilistic Programming Languages*. PI: Steven Holtzen. Award total: $674,830. Award period June 1, 2025 – May 31 2030.
2. *NSF Formal Methods in the Field (FMiTF): Track I: Principles for Modular Probabilistic Programming and Inference*. Award #2220408. PI: Steven Holtzen, effort: 50%. Co-PI: Amal Ahmed, effort: 50%. Award total $750,000. Award period October 2022 – September 2026.
3. *Advanced Development of Probabilistic Programming Languages for System Verification*. Contract from Sandia National Laboratories. PI: Steven Holtzen, effort: 100%. Award total: $225,000.

Internal grants & funding

1. *Tier-1 Award: Supporting Procedural Creativity with Probabilistic Programming-based AI*. co-PI: Steven Holtzen, effort: 50%. Co-PI: Chris Martens, effort: 50%. Award total: $50,000.

TEACHING & ADVISING

Courses taught

Term	Code	Title
Spring 2026	CS4400/5400	Principles of Programming Languages
Fall 2025	CS7480	Seminar: Category Theory for Programming Languages
Fall 2024	CS4400/5400	Principles of Programming Languages
Spring 2024	CS4400/5400	Principles of Programming Languages
Fall 2023	CS7470	Seminar: Foundations of Probabilistic Programming
Fall 2022	CS4100	Introduction to Artificial Intelligence
Spring 2022	CS4100	Introduction to Artificial Intelligence
Fall 2021	CS7480	Special Topics: Probabilistic Programming

Post-Doctoral Researchers

- Jialu Bao. 2025 – Present.

Ph.D. Student Advisees

1. James Li. 2025 – Present.
2. Shubh Agrawal 2024 – Present.
3. John M. Li. 2022 – Present. Co-advised with Amal Ahmed. `https://johnm.li/`
4. Sam Stites. 2022 – Present. `https://stites.io/`

Undergraduate Advisees

1. Smaran Teja Penikelapati (2025 – Present).
2. Jack Czenszak (2022 – 2025). Now PhD. student at Yale University.

Masters Advisees

1. Mingtong Lin (2025 – Present).
2. Minsung Cho. 2022 – 2024. Now at Relational.ai.

Ph.D. Committee Member

1. Olek Gierczak. Northeastern University. Anticipated graduation 2026.
2. Lisa Oakley. Northeastern University. Graduated 2025.
3. Jules Jacobs. Radboud University. Gradated 2024.
4. Ming-Ho Yee. Northeastern University. Graduated 2024.
5. Abdelrahman Madkour. Northeastern University. Graduated 2024.
6. Eli Sennesh. Northeastern University. Graduated August 2023.
7. Ellen Arteca. Northeastern University. Graduated July 2023.

External & Visiting Students

These are students that are not at Northeastern that I work with on projects.

- Anthony D'Arienzo. Visited Summer 2024.
- Matthew Wang. Visited Summer 2022. Master's Student at UCLA.
- Poorva Garg. 2021 – 2023. PhD. Student at UCLA.
- William Cao. 2019 – 2021. Undergraduate at UCLA.
- Yu-Hsi (Ellie) Cheng. 2019 – 2022. Undergraduate at UCLA.
  Now PhD. student at MIT.
  Recipient of 2022 CRA Undergraduate Award (Honorable Mention)

PROFESSIONAL ACTIVITIES & SERVICE

Program Committee Member

- 2026 – SIGPLAN International Conference on Functional Programming (ICFP)
- 2026 – Logic in Computer Science (LICS)
- 2025 – SIGPLAN Symposium on Principles of Programming Languages (POPL)
- 2024 – SIGNPLAN Proceedings of the ACM on Programming Languages (OOPSLA)
- 2023 – SIGNPLAN Proceedings of the ACM on Programming Languages (OOPSLA)
- 2022 – Association for the Advancement of Artificial Intelligence (AAAI)
- 2022 – International Joint Conference on Artificial Intelligence (IJCAI)
- 2022 – SIGNPLAN Programming Language Design and Implementation (PLDI)
- 2021 – International Conference on Machine Learning (ICML)
- 2021 – Uncertainty in Artificial Intelligence (UAI)
- 2020 – International Conference on Machine Learning (ICML). *Top 33% Reviewer.*

- 2020 – SIGNPLAN International Workshop on Languages for Inference (LAFI 2020).
- 2020 – Conference on Artificial Intelligence (AAAI)
- 2020 – Uncertainty in Artificial Intelligence (UAI)
- 2019 – Conference on Artificial Intelligence (AAAI)
- 2019 – International Conference on Machine Learning (ICML)
- 2019 – Neural Information Processing Symposium (NeurIPS). *Top 50% Reviewer.*
- 2018 – Uncertainty in Artificial Intelligence (UAI)

External Reviewer

- 2023 –ACM SIGPLAN Symposium on Principles of Programming Languages (POPL)
- 2022 –ACM SIGPLAN Symposium on Principles of Programming Languages (POPL)

Journal Reviewing

- Journal of Artificial Intelligence Research
- Artificial Intelligence Journal
- Machine Learning

Organizing Service

- Co-Program Chair for *Workshop on Languages for Inference* (LAFI) POPL 2024.
  Webpage: `https://popl24.sigplan.org/home/lafi-2024`
- Co-Program Chair for *Workshop on Languages for Inference* (LAFI) POPL 2023.
  Webpage: `https://popl23.sigplan.org/home/lafi-2023`
- Co-organizer of the *Relational Representation Learning Workshop* at NeurIPS 2018.

Panels

- Panelist for National Science Foundation (2024, 2025).

UNIVERSITY SERVICE

- Undergraduate Curriculum Committee 2025.
- PhD. Admissions Committee 2024.
- Hiring Committee 2023.
- PhD. Admissions Committee 2022. Led the re-introduction of the in-person PhD. student visit-day.
- PhD. Admissions Committee 2021.

INVITED TALKS & PRESENTATIONS

1. *Scaling probabilistic programming up.* IFIP WG2.8 on Functional Programming.
2. *Decomposing Probability Distributions*. Invited Keynote at The Workshop on Verification of Probabilistic Programs (VeriProP), co-located with CAV 2024.
3. *Modular reasoning for probabilistic programs*, April 2024. Talk at Boston University and Cornell University.

4. *Introduction to Probabilistic Programming*, June 2023. Invited tutorial at Dagstuhl Workshop on *Scalable Analysis of Probabilistic Models and Programs*.
5. *ML Meets PL*, June 2023. Invited speaker for the PLDI Programming Languages Mentorship Workshop.
6. *Probabilistic Programming for Science and Fault Analysis*, 2022. Presented at Sandia National Laboratories.
7. *Exploiting Symmetry for Scaling Discrete Factor Graph Inference*, 2021. At DATA Lab at Northeastern University.
8. *Designing Languages for Probabilistic Reasoning*, 2021. Invited speaker for the Harvard University Programming Languages Reading Group.
9. *Languages for Probabilistic Reasoning*. Invited speaker at Northeastern University, University of Notre Dame, University of California Merced, and Oregon State University.
10. *Quantum Simulation with Probabilistic Inference*, 2021. Presented at Intel Principal Investigators Meeting.
11. *Scaling Exact Inference for Discrete Probabilistic Programs*, 2021. Invited presented at OOPSLA 2021, invited to speak at the Rutgers University Reading Group.
12. *Modular Exact Inference for Discrete Probabilistic Programs*, 2020. Invited speaker at the International Conference on Probabilistic Programming (PROBPROG).
13. *Generating and Sampling Orbits for Lifted Probabilistic Inference*, 2019. Invited speaker at the Conference on Uncertainty in Artificial Intelligence. *Oral full presentation*, 35 of 450 submissions invited.

Invited Summer Schools

- Oregon Programming Languages Summerschool (OPLSS) 2024. *Probabilistic Programming from the Ground Up*. Four 90-minute lectures. `https://www.khoury.northeastern.edu/home/sholtzen/oplss24-ppl/`
- French Spring School in Theoretical Computer Science *École de Printemps d'Informatique Théorique* 2026. Four lectures on the design and implementation of probabilistic programming languages. `https://conferences.cirm-math.fr/3489.html`
- Joint SPLASH/ISSTA Summer School 2026. Three hour introduction to probabilistic programming.