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 –

University of California, Los Angeles — Los Angeles, CA
Research Assistant, Department of Computer Science — Sept. 2017 – Aug. 2021

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

HONORS AND AWARDS

1. 2022 IEEE MICRO Top Pick Honorable Mention
   For *Logical Abstractions for Noisy Variational Quantum Algorithm Simulation*.
2. UCLA Computer Science Outstanding Graduating Ph.D. Student.
3. ACM SIGPLAN Distinguished Paper Award.
   Awarded at OOPSLA 2020 for *Scaling Exact Inference for Discrete Probabilistic Programs*.
4. (2015–2017) National Physical Sciences Consortium Fellowship

PUBLICATIONS

Conference publications

1. 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

2. 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

3. 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

4. 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

5. 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

6. 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

7. 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

8. 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

9. 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

10. 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

11. 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. 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*, 2024

2. Sam Stites and Steven Holtzen. A multi-language approach to probabilistic program inference. In *Workshop on Languages for Inference (LAFI) at POPL*, 2024

3. 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

4. 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

5. 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

6. 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

7. 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
8. Steven Holtzen, Todd Millstein, and Guy Van den Broeck. Symbolic exact inference for discrete probabilistic programs. In *Workshop on Tractable Probabilistic Modeling (TPM)*, 2019a
9. 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
10. 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
11. 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. *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.
2. *Advanced Development of Probabilistic Programming Languages for System Verification*. Contract from Sandia National Laboratories. PI: Steven Holtzen, effort: 100%. Award total: $153,000.

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

1. **CS4400/5400: Introduction to Programming Languages.**
   Northeastern University, Spring 2024.
2. **CS7470: Seminar in Programming Languages: Foundations of Probabilistic Programming**
   Webpage: `https://www.khoury.northeastern.edu/home/sholtzen/CS7470Fall23/`
   Northeastern University, Fall 2023
3. **CS4100: Introduction to Artificial Intelligence**
   Northeastern University, Fall 2022
4. **CS4100: Introduction to Artificial Intelligence**
   Northeastern University, Winter 2022
5. **CS 7480: Topics in Programming Languages: Probabilistic Programming**
   Webpage: `https://www.khoury.northeastern.edu/home/sholtzen/CS7480Fall21/`
   Northeastern University, Fall 2021.

Ph.D. Student Advisees

1. Sarah Marshall 2023 – Present. Co-advised with Amal Ahmed. `https://www.sarahmarshall.name/`
2. John M. Li. 2022 – Present. Co-advised with Amal Ahmed. `https://johnm.li/`
3. Minsung Cho. 2022 – Present. `https://cho.minsung.pl/`
4. Sam Stites. 2022 – Present. `https://stites.io/`

Undergraduate Advisees

1. Jack Czenszak

Ph.D. Committee Member

1. Jules Jacobs. Radboud University.
2. Ming-Ho Yee. Northeastern University. Anticipated graduation 2024.
3. Abdelrahman Madkour. Northeastern University. Anticipated graduation 2024.
4. Eli Sennesh. Northeastern University. Graduated August 2023.
5. Ellen Arteca. Northeastern University. Graduated July 2023.

External & Visiting Students

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

- Matthew Wang. 2022 – Present. Master's Student at UCLA.
- Poorva Garg. 2021 – Present. PhD. Student at UCLA.
- William Cao. 2019 – Present. 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

- 2023 – 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 – 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 – 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).

UNIVERSITY SERVICE

- 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. *Introduction to Probabilistic Programming*, June 2023. Invited tutorial at Dagstuhl Workshop on *Scalable Analysis of Probabilistic Models and Programs*.
2. *ML Meets PL*, June 2023. Invited speaker for the PLDI Programming Languages Mentorship Workshop.
3. *Probabilistic Programming for Science and Fault Analysis*, 2022. Presented at Sandia National Laboratories.
4. *Exploiting Symmetry for Scaling Discrete Factor Graph Inference*, 2021. At DATA Lab at Northeastern University.
5. *Designing Languages for Probabilistic Reasoning*, 2021. Invited speaker for the Harvard University Programming Languages Reading Group.
6. *Languages for Probabilistic Reasoning*. Invited speaker at Northeastern University, University of Notre Dame, University of California Merced, and Oregon State University.

7. *Quantum Simulation with Probabilistic Inference*, 2021. Presented at Intel Principal Investigators Meeting.
8. *Scaling Exact Inference for Discrete Probabilistic Programs*, 2021. Invited presented at OOPSLA 2021, invited to speak at the Rutgers University Reading Group.
9. *Modular Exact Inference for Discrete Probabilistic Programs*, 2020. Invited speaker at the International Conference on Probabilistic Programming (PROBPROG).
10. *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.