# Christopher Waites

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## EDUCATION

2019– M.S. in Computer Science, Stanford University

2015–19 B.S. in Computer Science, *summa cum laude*, Georgia Institute of Technology

- Thesis: *Towards Increasingly Practical Tools for Differentially Private Deep Learning*
- Advised by: Rachel Cummings

## RESEARCH EXPERIENCE

2020– Research Intern
*Nuro AI, Mountain View, California (Advised by: Wei Liu)*

- Investigating distributional reinforcement learning methods for risk-aware decision making in autonomous vehicle control. Generalizing worst-case policy gradient (WCPG) to handle non-Gaussian long-term reward distributions.

2018– Research Assistant
*Georgia Institute of Technology, Atlanta, Georgia (Advised by: Rachel Cummings)*

- Sole investigator of novel approach to differentially private density estimation using normalizing flow models, enabling privacy-preserving likelihood evaluation and synthetic data generation. Convincingly improves upon relevant baselines based off of traditional statistical methods.
- Aided in design and led empirical evaluation of differentially private approach to synthetic data generation via generative adversarial networks, allowing for arbitrary-type data synthesis.
- Developed earliest formal PyTorch library for differentially private optimization.

2019–20 Research Assistant
*Stanford University, Stanford, California (Advised by: Dan Yamins)*

- Contributed to unsupervised vision models for scene understanding, capable of converting images to particle-based hierarchical representations without reference to ground-truth information.
- Constructed a system for performing physical dynamics prediction directly from vision by combining vision model with a differentiable physics simulator based off of a graph neural network.

2019 Research Fellow
*UnifyID, Redwood City, California (Advised by: Vinay Prabhu)*

- Improved upon existing approaches (GMM-UBM) to biometric authentication from time-series data (e.g. accelerometric data corresponding to gait cycles) using normalizing flow models.

2017–18 Research Assistant
*Georgia Institute of Technology, Atlanta, Georgia (Advised by: Melody Jackson)*

- Investigated signal processing and time series analysis techniques for human activity recognition from EEG data. Conducted a series of controlled human subject trials requiring IRB approval.

## PAPERS

2020 Chris Waites* and Rachel Cummings. Differentially private normalizing flows for privacy-preserving density estimation. In *International Conference on Machine Learning Workshop in Invertible Neural Networks, Normalizing Flows, and Explicit Likelihood Models*, 2020

2019 Uthaipon Tantipongpipat*, Chris Waites*, Digvijay Boob, Amaresh Ankit Siva, and Rachel Cummings. Differentially private mixed-type data generation for unsupervised learning. 2019. URL `http://arxiv.org/abs/1912.03250`

2018 Digvijay Boob, Rachel Cummings, Dhamma Kimpara, Uthaipon Tantipongpipat, Chris Waites, and Kyle Zimmerman. Differentially private synthetic data generation via gans. In *ACM CCS Workshop on the Theory and Practice of Differential Privacy*, 2018

## TALKS

2020 Differentially Private Normalizing Flows for Privacy-Preserving Density Estimation
*Poster at the 2nd ICML Workshop on Invertible Neural Networks, Normalizing Flows, and Explicit Likelihood Models*

2019 Privacy-Preserving Deep Learning
*Guest Lecture for CS271: AI in Healthcare, Stanford University, Stanford, California*

2018 Differentially Private Synthetic Data Generation
*Two Sigma Investments, New York City, New York*

2018 Differentially Private Synthetic Data Generation via GANs
*Poster at the ACM CCS'18 Workshop on the Theory and Practice of Differential Privacy*

2017 Topics in Theoretical Computer Science
*Facebook Inc., Menlo Park, California*

## AWARDS

2019 Full-Tuition Guaranteed TAship
*Stanford University, Stanford, California*

2019 $20,000 First Prize Winner and People's Choice Award, Privacy Engineering Challenge
*National Institute of Standards and Technology, Public Safety Communications Research Division*

2018 $2,000 President's Undergraduate Research Award
*Georgia Institute of Technology, Atlanta, Georgia*

2015 Full-Tuition Zell Miller Academic Scholarship
*Georgia Institute of Technology, Atlanta, Georgia*

## OPEN SOURCE

2020 `JaxFlows`: Normalizing flow library for the JAX deep learning framework.
`https://github.com/ChrisWaites/jax-flows`

2018 `PyVacy`: Differentially private optimization in PyTorch.
`https://github.com/ChrisWaites/pyvacy`

## TEACHING

2020 CS231n: Convolutional Neural Networks for Visual Recognition
*Stanford University (Advised by: Fei-Fei Li)*

2020 CS230: Deep Learning
*Stanford University (Advised by: Andrew Ng)*

2019 CS221: Artificial Intelligence
*Stanford University (Advised by: Percy Liang & Dorsa Sadigh)*

2018 CS7646: Machine Learning for Trading
*Georgia Institute of Technology (Advised by: Tucker Balch)*

2017 CS3600: Artificial Intelligence
*Georgia Institute of Technology (Advised by: Mark Riedl)*

2016 CS1331: Object-Oriented Programming
*Georgia Institute of Technology (Advised by: Chris Simpkins)*

## EMPLOYMENT

2019 Software Engineering Intern
*Two Sigma Investments, Market Making*

- Developed dynamic programming algorithm to partition trading simulations in a provably optimal manner under theoretical characterization, improving efficiency by $\approx 5\%$ over heuristic approach

2018 Software Engineering Intern
*Airbnb Inc., International Payments Team*

2018 Software Engineering Intern
*Facebook Inc., Probability Team*

2017 Software Engineering Intern
*Bloomberg L.P., Derivatives Pricing Team*

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