

JONATHAN KUCK

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EDUCATION

Stanford University

PhD student in Computer Science

Fall 2015 - Present

University of Illinois, Urbana-Champaign

B.S. in Engineering Physics, minor Computer Science

Fall 2007 - Spring 2015

RESEARCH EXPERIENCE

Approximating the Matrix Permanent

2018-2019

With Professor Stefano Ermon

Stanford

- Designed a novel algorithm for exactly sampling permutations from the distribution defined by the matrix permanent with **provably polynomial runtime scaling** on dense matrices.
- Observed **12-25x** speedups over prior work on real world matrices.
- Applied the method to the multi-target tracking problem, facilitating sampling from the optimal proposal distribution in a particle filter, thus improving tracking performance with a fixed sample size.
- Published first author paper in NeurIPS 2019.

Propositional Model Counting

2017-2019

With Professor Stefano Ermon

Stanford

- Proposed a variance reduction scheme and adaptive framework for randomized hashing schemes.
- Experimentally tested both methods on a suite of benchmarks. Found that in combination our methods improved lower bounds with short constraints by a median **factor of 2^9** over 1206 nontrivial problems.
- Demonstrated improvements in bound-runtime trade-off against longer constraints. Showed it is possible to improve both the computed lower bound and the runtime required to compute the bound by orders of magnitude.
- Published first author paper in UAI 2019.

Weighted Rademacher Complexity

2017

With Professor Stefano Ermon

Stanford

- Extended the notion of Rademacher complexity to the weighted setting.
- Demonstrated applicability to approximate inference for counting (#SAT) and integration (Ising model).
- Published first author paper in AAAI 2018.

Target Tracking

2016-Present

With Professor Stefano Ermon

Stanford

- Developed a generative model, learning method, and tractable inference scheme to perform multi-sensor, multi-target tracking.
- Achieved **state of the art performance** on the KITTI target tracking benchmark for autonomous vehicles.
- Submitted first author paper to ICML 2017.

Image Classification
With Professor Chris Re

Winter 2016
Stanford

- Explored new image classification algorithms for **training with noisy labels**.
- Jointly trained a CNN and standard neural network to simultaneously learn image features and a distance metric in the learned feature space.
- Found classification improvements over a standalone CNN in the case of large training noise.

Astronomy Image Processing
With Professor Pat Hanrahan

Summer-Fall 2015
Stanford

- Identified costly and common operations in the Large Synoptic Survey Telescope imaging pipeline.
- Prototyped a domain specific language for astronomical image processing.
- Achieved **5-10x speedups** for language primitives compared to the current method.

Outlier Detection
With Professor Jiawei Han

2014
UIUC

- Developed an outlier detection algorithm for use in large heterogeneous information networks that supports **flexible user queries** for efficiently finding specific types of outliers.
- Evaluated practical effectiveness by conducting experiments on the DBLP database of CS publications.
- Published co-first author paper in EDBT 2015.

N-body Simulation
With Professor Laxmikant Kale

2013
UIUC

- Developed in Charm++, a portable, message driven, parallel programming system that includes dynamic load balancing, and fault tolerance.
- Implemented an n-body simulator for use with gravitational or electrical inter-body forces.
- Optimized simulation by dynamically splitting and merging processes during particle migration to eliminate a global synchronization barrier.

PUBLICATIONS

- **Jonathan Kuck**, Tri Dao, Hamid Reza Tofighi, Ashish Sabharwal, and Stefano Ermon. *Approximating the Permanent by Sampling from Adaptive Partitions*. In NeurIPS, 2019.
- **Jonathan Kuck**, Tri Dao, Shengjia Zhao, Burak Bartan, Ashish Sabharwal, and Stefano Ermon. *Adaptive Hashing for Model Counting*. In UAI, 2019.
- **Jonathan Kuck**, Ashish Sabharwal, and Stefano Ermon. *Approximate Inference via Weighted Rademacher Complexity*. In AAAI, 2018.
- **Jonathan Kuck***, Honglei Zhuang*, Xifeng Yan, Hasan Cam, and Jiawei Han. *Query-Based Outlier Detection in Heterogeneous Information Networks*. In EDBT, 2015.

WORK EXPERIENCE

Calibrated Uncertainties in Deep Learning
With Qiangui Huang and Ashesh Jain

Summer 2019
Lyft Level 5, Self-Driving

- Improved classification calibration of in house object detector using temperature scaling.
- Trained an object detector with a variety of proper score rules to predict calibrated position uncertainty.
- Improved final mAP of object detector using learned uncertainty during non-maximum suppression.
- Prototyped a set transformer based approach for learning non-maximum suppression.

TEACHING

- Probabilistic Graphical Models (head TA, Winter 2018): Recognized as one of the top 5% of CS course assistants this quarter.

EXTRACURRICULAR

- Speedskating: **Olympic medalist** (team pursuit), world champion (team pursuit), and world championship medalist (individual).