Jacob Imola

Contact Information

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Education

University of California, San Diego   2018-Now
PhD Student in Computer Science, Expected Graduation 2024
Advisor: Prof. Kamalika Chaudhuri
Carnegie Mellon University   2014-2018
B.S. in Computer Science, Minor in Mathematics
Advisor: Prof. Jean Yang
GPA: 3.85/4.00

Research Experience

PhD Research   September 2018-
Differential Privacy and Other Topics in Machine Learning   Now

- **Local Differential Privacy and Graphs:** Created new graph algorithms where each user has a list of his neighbors and applies a private mechanism locally. Combined techniques from graph sampling and privacy to improve communication. See https://arxiv.org/abs/2110.06485 for a selected work.

- **Privacy Amplification via Post-Sampling:** Analyzed privacy amplification, or the improvement in privacy guarantee, when a private algorithm is used to learn a posterior distribution, and then a sample from that distribution is released. Proved lower and upper bounds on amplification for Bernoulli posterior. See https://arxiv.org/abs/2105.10594 for the paper.

- **Clustering in the Online Setting:** Developed new k-means clustering algorithm where points are streamed one at a time, may be arbitrary, and cannot be removed if selected. The algorithm always runs efficiently and provides a constant-factor approximation to the optimal clustering. See https://arxiv.org/abs/2102.09101 for the paper.

- **Privacy in Context of Limited Adversaries:** Proposed new privacy definition that considers adversaries with capacity limitations, such as a bounded function class. Proved capacity-bounded privacy satisfies the familiar properties of differential privacy, and derived mechanisms for it. See https://arxiv.org/abs/1907.02159 for the paper.

Undergraduate Thesis   May 2017-
Programming Languages and Differential Privacy   June 2018

- **Automatic, Fine-Grained Choice for Differential Privacy:** Proposed framework to automatically explore and optimize privacy-accuracy frontier of differential privacy. Devised type system and runtime environment to provide abstract interface for performing the optimization. Tested code on real datasets and demonstrated performance improvements.

Undergraduate Research   May 2015-
Complexity Theory   August 2015

- **Multiparty Communication Protocols for Symmetric Functions:** Investigated general multiparty communication protocols in which each party has a string on their forehead, communicates with bits, and seeks to compute a weakly symmetric function. Collaborated with others to produce a catalog of questions and results. Developed simulations of random boolean circuits with C++.

Work Experience

PhD Intern   June 2021-
Applied Scientist at Amazon   September 2021

- **Towards an Optimal Mechanism in Metric Privacy:** Formulated utility definition for textual differential privacy algorithm. Applied techniques from linear programming to find new algorithm that had approx. 20% better utility while still meeting privacy guarantees. Devised heuristics to speed up algorithm and improve scalability to real-world text applications.

Summer Intern   June 2017-
Quantitative Market Researcher at Jump Trading   August 2017

- **Financial Market Prediction Algorithms:** Cleaned and organized data from different markets. Hypothesized possible market patterns and calculated statistical significance. Optimized algorithms and authored production-ready code which was used to improve profits.

Summer Intern   June 2016-
Software Engineer at Salesforce   August 2016

- **Data Quality Visualization Dashboard:** Analyzed data quality of data center computer metrics. Visualized data with an interactive Django website. Discovered data inconsistencies which helped company identify longstanding bugs.

Teaching Experience

High School Research Mentor   June 2021-
Summer STEM Institute   July 2021

Teaching Assistant   January 2021-
CSE 151A: Introduction to AI: A Statistical Approach   March 2021

Teaching Assistant   January 2020-
CSE 151A: Introduction to AI: A Statistical Approach   March 2020

Publications

Communication-Efficient Triangle Counting under Local Differential Privacy
In submission; arXiv version available at https://arxiv.org/abs/2110.06485

No-Substitution k-means Clustering with Low Center Complexity and Memory
In submission; arXiv version available at https://arxiv.org/abs/2102.09101

Privacy Amplification Via Bernoulli Sampling
Accepted to TPDP Workshop at ICML 2021; arXiv version available at https://arxiv.org/abs/2105.10594

Locally Differentially Private Analysis of Graph Statistics
Accepted at USENIX Security 2021; arXiv version available at https://arxiv.org/abs/2010.08688

Capacity Bounded Differential Privacy
Accepted at NeurIPS 2019; arXiv version available at https://arxiv.org/abs/1907.02159

Computer Skills

Programming Languages:	C++, Python, OCaml, Java, R, Javascript, SQL, LaTeX
Industrial Tools:	Numpy/Scipy, Scikit-learn, Sage, React.js

Academic Honors

2018	Senior Thesis Honors Program at CMU
2016	William Lowell Putnam Math Competition Honorable Mention
2015	ACM-ICPC Regional Programming Competition Team Member