Noah Singer

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Education

2022– **Ph.D. in Computer Science**, *Carnegie Mellon University*, Computer Science Department, School of Computer Science, Pittsburgh, PA
Coadvised by Ryan O'Donnell and Aayush Jain. Supported by an NSF GRFP fellowship.

2018–2022 **A.B. in Computer Science and Mathematics**, *Harvard University*, Harvard College, Cambridge, MA
Magna cum laude with highest honors in field, GPA 3.97. Research mentored by Madhu Sudan.

Research Interests

I am broadly interested in complexity and algorithms; the use of mathematical techniques towards answering questions in these areas; and applications to areas like cryptography, coding theory, quantum computing, and combinatorics. My recent research mostly focuses on combinatorial optimization and average-case problems. I also have an ongoing project on understanding the approximability of constraint satisfaction problems in streaming models, resulting in several publications [8, 5, 2, 1, 4] and my undergraduate thesis [6].

Papers

Publications

[1] Raghuvansh R. Saxena, Noah Singer, Madhu Sudan, and Santhoshini Velusamy. "Improved Streaming Algorithms for Maximum Directed Cut via Smoothed Snapshots". In: *63rd Annual Symposium on Foundations of Computer Science* (Santa Cruz, CA, USA, Nov. 6–9, 2023). IEEE Computing Society, 2023.

[2] Raghuvansh R. Saxena, Noah G. Singer, Madhu Sudan, and Santhoshini Velusamy. "Streaming Complexity of CSPs with Randomly Ordered Constraints". In: *Proceedings of the 2023 Annual ACM-SIAM Symposium on Discrete Algorithms*. SODA 2023 (Florence, Italy, Jan. 22–25, 2023). Jan. 2023. DOI: 10.1137/1.9781611977554.ch156.

[3] Noah G. Singer. "Borges and the Aesthetics of Computation". In: *Variaciones Borges* 56 (Oct. 2023).

[4] Noah G. Singer. "Oblivious Algorithms for the Max-kAND Problem". In: *Approximation, Randomization, and Combinatorial Optimization. Algorithms and Techniques*. APPROX 2023 (Atlanta, GA, USA, Sept. 11–13, 2023). Ed. by Nicole Megow and Adam D. Smith. Vol. 275. LIPIcs. May 2023. DOI: 10.4230/LIPIcs.APPROX/RANDOM.2023.15.

[5] Joanna Boyland, Michael Hwang, Tarun Prasad, Noah Singer, and Santhoshini Velusamy. "On Sketching Approximations for Symmetric Boolean CSPs". In: *Approximation, Randomization, and Combinatorial Optimization. Algorithms and Techniques*. APPROX 2022 (virtual, Sept. 19–21, 2022). Ed. by Amit Chakrabarti and Chaitanya Swamy. Vol. 245. LIPIcs. Schloss Dagstuhl — Leibniz-Zentrum für Informatik, July 2022, 38:1–38:23. DOI: 10.4230/LIPIcs.APPROX/RANDOM.2022.38.

[7] Noah Singer and Madhu Sudan. "Point-Hyperplane Incidence Geometry and the Log-Rank Conjecture". In: *ACM Transactions on Computation Theory* 14.2 (June 2022). DOI: 10.1145/3543684.

[8] Noah Singer, Madhu Sudan, and Santhoshini Velusamy. "Streaming Approximation Resistance of Every Ordering CSP". In: *Approximation, Randomization, and Combinatorial Optimization. Algorithms and Techniques*. APPROX 2021 (virtual, Aug. 16–18, 2021). Ed. by Mary Wootters and Laura Sanità. Vol. 207. LIPIcs. Schloss Dagstuhl — Leibniz-Zentrum für Informatik, July 2021, 17:1–17:19. DOI: 10.4230/LIPIcs.APPROX/RANDOM.2021.17.

Thesis

[6] Noah Singer. "On Streaming Approximation Algorithms for Constraint Satisfaction Problems". BA thesis. Cambridge, MA: Harvard University, Mar. 2022. 140 pp. URL: https://nrs.harvard.edu/URN-3:HUL.INSTREPOS:37371750.

Awards

Spring 2022 **NSF GRFP Fellowship**

Spring 2022 **Hoopes Prize**
$5k award from Harvard College for undergraduate thesis [6].

Spring 2022 **CRA Outstanding Undergraduate Researcher Award**, Honorable Mention

Fall 2021 **Harvard College Research Program Grant**
$800 grant supporting work on sketching complexity of constraint satisfaction, and eventual publication in APPROX [5] and undergraduate thesis [6].

Spring 2021 **Phi Beta Kappa, Alpha Iota of Massachusetts**
Elected in group of 24 juniors from the Harvard College Class of 2022.

2019–2021 **Certificate of Distinction in Teaching**
Four awards from Harvard Office of Undergraduate Education on basis of instructor ratings in student evaluations. Overall scores were (/5): CS 121 Fall 2019, 4.83; CS 121 Fall 2020, 4.88; CS 124 Spring 2021, 4.82; CS 121 Fall 2021, 4.79.

Summer 2020 **Herchel Smith-Harvard Undergraduate Research Fellow**
$5K grant supporting research on log-rank conjecture and incidence geometry, leading to work published in *ACM Transactions on Computation Theory* [7].

Teaching Experience

Fall 2023 **Teaching Assistant**, *15-459: Undergraduate Quantum Computation*, Department of Computer Science, Carnegie Mellon University
Instructor: Ryan O'Donnell.

Fall 2022 **Volunteer**, *CS 229r: Information Theory in Computer Science*, School of Engineering and Applied Sciences, Harvard University
Instructor: Madhu Sudan. Responsible for detailed feedback and edits on scribe notes; see course site.

Summer 2022 **Teaching Assistant**, *New Horizons in Theoretical Computer Science Summer School*, Toyota Technological Institute at Chicago

Fall 2021 **Teaching Fellow**, *CS 121: Introduction to Theoretical Computer Science*, School of Engineering and Applied Sciences, Harvard University
Instructors: Madhu Sudan and Adam Hesterberg.

Spring 2021 **Teaching Fellow**, *CS 124: Introduction to Algorithms*, School of Engineering and Applied Sciences, Harvard University
Instructors: Michael Mitzenmacher and Adam Hesterberg.

Fall 2020 **Teaching Fellow**, *CS 121: Introduction to Theoretical Computer Science*, School of Engineering and Applied Sciences, Harvard University
Instructors: Madhu Sudan and Adam Hesterberg.

Spring 2020 **Teaching Fellow**, *CS 161: Operating Systems*, School of Engineering and Applied Sciences, Harvard University
Instructor: James Mickens.

Fall 2019 **Teaching Fellow**, *CS 121: Introduction to Theoretical Computer Science*, School of Engineering and Applied Sciences, Harvard University
Instructors: Boaz Barak and Madhu Sudan. Organized "CS 121.5" advanced section with weekly guest speakers; see notes. (Co-)organized similar seminars in CS 121 (Fall 2020) and CS 124 (Spring 2021).

Internships

Summer 2021 **Research Intern**, *DIMACS REU @ Rutgers University*, remote
Worked with Prof. Eric Allender on complexity of circuit minimization and related problems. Supported by NSF grant CCF-1852215. See blog.

Summer 2019 **Software Engineering Intern**, *Airbnb*, San Francisco, CA
Built a production data pipeline to discover and manage large quantities of search advertising keywords targeting Airbnb hosts, efficiently scaling up listing creation due to search ads by over 20% and generating tens of thousands of dollars in weekly revenue.

Invited Talks

Mar. 15, 2023 **CMU Theory Lunch**
Title: "Improved streaming approximation algorithms for Maximum Directed Cut."

Nov. 17, 2022 **Harvard Student Theory Seminar ("TGINF")**
Title: *A tale of two streaming CSPs*. Based on joint works [5, 2, 1].

Service

Fall 2022 **Graduate Application Support Program (GASP) Mentor**, *Carnegie Mellon University*, School of Computer Science

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