

# Noah G. Singer

✉ [ngsinger@cs.cmu.edu](mailto:ngsinger@cs.cmu.edu)  
📄 [noahsinger.org](http://noahsinger.org)

S, Su, F, and W denote spring, summer, fall, and winter, respectively.

---

## Education

F<sup>22</sup>– **Ph.D. in Computer Science**, *Carnegie Mellon University*, Pittsburgh, PA  
Coadvised by Ryan O'Donnell and Aayush Jain. Supported by an NSF GRFP fellowship.

F<sup>22</sup>–S<sup>24</sup> **M.S. in Computer Science – Research**, *Carnegie Mellon University*, Pittsburgh, PA

F<sup>18</sup>–S<sup>22</sup> **A.B. in Computer Science and Mathematics**, *Harvard University*, 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 focuses on two areas:

- Algebraic constructions of high-dimensional expander complexes [4].
- Approximability of constraint satisfaction problems in streaming models [2, 3, 11, 8, 7, 10, 5] (and undergraduate thesis [12]).

---

## Papers

### Manuscripts

- [3] Samuel Hwang, Noah G. Singer, and Santhoshini Velusamy. “Oblivious Algorithms for Maximum Directed Cut: New Upper and Lower Bounds”. In submission. May 2024.
- [4] Ryan O'Donnell and Noah G. Singer. “Coboundary Expansion inside Chevalley Coset Complex HDXs”. In submission. Nov. 8, 2024. arXiv: [2411.05916](https://arxiv.org/abs/2411.05916).

### Conference Publications

- [1] Keerthana Gurushankar, Noah G. Singer, and Bernardo Subercaseaux. “Latency Guarantees for Caching with Delayed Hits”. In: *IEEE International Conference on Computer Communications*. INFOCOM 2025 (London, UK, May 19–22, 2025). IEEE Computer Society, 2025.
- [2] Raghuvansh Saxena, Noah G. Singer, Madhu Sudan, and Santhoshini Velusamy. “Streaming Algorithms via Local Algorithms for Maximum Directed Cut”. In: SODA 2025 (New Orleans, LA, USA, Jan. 12–15, 2025). 2025.
- [7] 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*. FOCS 2023 (Santa Cruz, CA, USA, Nov. 6–9, 2023). IEEE Computing Society, 2023, pp. 855–870. DOI: [10.1109/FOCS57990.2023.00055](https://doi.org/10.1109/FOCS57990.2023.00055).

- [8] Raghuvaran 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). Society for Industrial and Applied Mathematics, Jan. 2023, pp. 4083–4103. DOI: [10.1137/1.9781611977554.ch156](https://doi.org/10.1137/1.9781611977554.ch156).
- [10] Noah G. Singer. “Oblivious Algorithms for the Max- $k$ AND 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](https://doi.org/10.4230/LIPIcs.APPROX/RANDOM.2023.15).
- [11] 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](https://doi.org/10.4230/LIPIcs.APPROX/RANDOM.2022.38).
- [14] 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. Conference version of [5]. Schloss Dagstuhl — Leibniz-Zentrum für Informatik, July 2021, 17:1–17:19. DOI: [10.4230/LIPIcs.APPROX/RANDOM.2021.17](https://doi.org/10.4230/LIPIcs.APPROX/RANDOM.2021.17).

### Journal Publications

- [5] Noah Singer, Madhu Sudan, and Santhoshini Velusamy. “Streaming Approximation Resistance of Every Ordering CSP”. In: *Computational Complexity* 33 (2024). Journal version of [14], p. 6. DOI: [10.1007/s00037-024-00252-5](https://doi.org/10.1007/s00037-024-00252-5).
- [13] 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](https://doi.org/10.1145/3543684).

### Miscellanea

- [6] Noah G. Singer. *Better Streaming Algorithms for Maximum Directed Cut via "Snapshots"*. CMU CSD PhD Blog. Apr. 11, 2024. URL: <https://www.cs.cmu.edu/~csd-phd-blog/2024/streaming-csps/>.
- [9] Noah G. Singer. “Borges and the Aesthetics of Computation”. In: *Variaciones Borges* 56 (Oct. 2023).
- [12] 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

S<sup>22</sup> **NSF GRFP Fellowship**

S<sup>22</sup> **Hoopes Prize**

\$5k award from Harvard College for undergraduate thesis [12].

S<sup>22</sup> **CRA Outstanding Undergraduate Researcher Award**, Honorable Mention

F<sup>21</sup> **Harvard College Research Program Grant**

\$800 grant supporting work on sketching complexity of constraint satisfaction, and eventual publication in APPROX [11] and undergraduate thesis [12].

S<sup>21</sup> **Phi Beta Kappa, Alpha Iota of Massachusetts**

Elected in group of 24 juniors from the Harvard College Class of 2022.

- F<sup>19</sup>–F<sup>21</sup> **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* F<sup>19</sup>, 4.83; *CS 121* F<sup>20</sup>, 4.88; *CS 124* S<sup>21</sup>, 4.82; *CS 121* F<sup>21</sup>, 4.79.
- Su<sup>20</sup> **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* [13].

---

## Teaching Experience

- F<sup>23</sup> **Teaching Assistant, 15-754: Spectral Graph Theory**, Computer Science Department, Carnegie Mellon University  
Instructors: Jason Li and Ryan O'Donnell.
- F<sup>23</sup> **Teaching Assistant, 15-459: Undergraduate Quantum Computation**, Computer Science Department, Carnegie Mellon University  
Instructor: Ryan O'Donnell.
- F<sup>22</sup> **Teaching Volunteer, CS 229r: Information Theory in Computer Science**, School of Engineering and Applied Sciences, Harvard University  
Instructor: Madhu Sudan. Remote. Responsible for detailed feedback and edits on scribe notes; see [course site](#).
- Su<sup>22</sup> **Teaching Assistant, New Horizons in Theoretical Computer Science Summer School**, Toyota Technological Institute at Chicago
- F<sup>21</sup> **Teaching Fellow, CS 121: Introduction to Theoretical Computer Science**, School of Engineering and Applied Sciences, Harvard University  
Instructors: Madhu Sudan and Adam Hesterberg.
- S<sup>21</sup> **Teaching Fellow, CS 124: Introduction to Algorithms**, School of Engineering and Applied Sciences, Harvard University  
Instructors: Michael Mitzenmacher and Adam Hesterberg.
- F<sup>20</sup> **Teaching Fellow, CS 121: Introduction to Theoretical Computer Science**, School of Engineering and Applied Sciences, Harvard University  
Instructors: Madhu Sudan and Adam Hesterberg.
- S<sup>20</sup> **Teaching Fellow, CS 161: Operating Systems**, School of Engineering and Applied Sciences, Harvard University  
Instructor: James Mickens.
- F<sup>19</sup> **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 (F<sup>20</sup>) and CS 124 (S<sup>21</sup>).

---

## Internships

- Su<sup>21</sup> **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](#).

Su<sup>19</sup> **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

- 03/15/23 **CMU Theory Lunch**  
Title: *Improved streaming approximation algorithms for Maximum Directed Cut*. Video recording available on [YouTube](#).
- 11/17/22 **Harvard Student Theory Seminar (“TGINF”)**  
Title: *A tale of two streaming CSPs*. Based on joint works [11, 8, 7].

---

## Service

- W<sup>24</sup> **Ph.D. Admissions Committee Member, Carnegie Mellon University, Computer Science Department**
- S<sup>24</sup>–F<sup>24</sup> **Writing Skills Committee Member, Carnegie Mellon University, Computer Science Department**  
Served on department writing requirement committees, giving detailed feedback for blog posts by Orestis Chardouvelis (“[Efficient Anonymous Blocklisting](#)”) and Joseph Reeves (“Encoding Cardinality Constraints in Automated Reasoning”).
- S<sup>23</sup>, S<sup>24</sup> **Open House Committee Member, Carnegie Mellon University, Computer Science Department**
- F<sup>23</sup>, F<sup>24</sup> **Introductory Course Committee Member, Carnegie Mellon University, Computer Science Department**  
Organized outings for new students, including to Pittsburgh Pirates baseball games, the Carnegie Museum of Art, the Warhol Museum, Row House Cinemas, the Pittsburgh Symphony Orchestra, the Carrie Blast Furnace, and Pittsburgh Shakespeare in the Parks, as well as welcome events for new theory students.
- S<sup>24</sup>, F<sup>24</sup> **Theory Lunch Co-Organizer, Carnegie Mellon University, Computer Science Department**
- F<sup>23</sup> **Reading Group Organizer for High-Dimensional Expanders and Coding Theory, Carnegie Mellon University, Computer Science Department**
- F<sup>24</sup>, F<sup>22</sup> **Graduate Application Support Program (GASP) Mentor, Carnegie Mellon University, Computer Science Department**

Updated December 11, 2024.