

JOSHUA D. BRAKENSIEK, PH.D.

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*Curriculum Vitae*

- Education**
- STANFORD UNIVERSITY 2018 – Jan 2024  
Doctor of Philosophy in Computer Science  
Co-advisors: Aviad Rubinfeld and Moses Charikar  
Thesis: “Higher Order MDS Codes”
- STANFORD UNIVERSITY 2018 – 2021  
Master’s of Science in Computer Science  
Qualification Exam Topic: “Automated Design of Error-Correcting Codes”
- CARNEGIE MELLON UNIVERSITY 2016 – 2018  
Master’s of Science in Mathematical Sciences  
Thesis: “Polymorphic Inquiries: Promise Constraint Satisfaction and Beyond”  
Advisor: Venkatesan Guruswami
- CARNEGIE MELLON UNIVERSITY 2014 – 2018  
Bachelor’s of Science in Mathematical Sciences  
Minor in Science, Technology, and Society  
University and Mellon College of Science Honors  
GPA: 4.00/4.00
- Publications**
- ROBUST FACTORIZATIONS AND COLORINGS OF TENSOR GRAPHS  
**Brakensiek, J.** and Davies, S.  
SIAM Journal on Discrete Mathematics (SIDMA), 2024. arXiv:2207.08913
- AG CODES ACHIEVE LIST DECODING CAPACITY OVER CONSTANT-SIZED FIELDS  
**Brakensiek, J.**, Dhar, M., Gopi, S., and Zhang, Z.  
Symposium on Theory of Computing (STOC), 2024. arXiv:2310.12898
- GENERALIZED GM-MDS: POLYNOMIAL CODES ARE HIGHER ORDER MDS  
**Brakensiek, J.**, Dhar, M., and Gopi, S.  
Symposium on Theory of Computing (STOC), 2024. arXiv:2310.12888
- TIGHT APPROXIMABILITY OF MAX 2-SAT AND RELATIVES, UNDER UGC  
**Brakensiek, J.**, Huang, N., and Zwick, U.  
Symposium on Discrete Algorithms (SODA), 2024. arXiv:2310.12911
- SEPARATING MAX 2-AND, MAX DI-CUT AND MAX CUT  
**Brakensiek, J.**, Huang, N., Potechin, A., and Zwick, U.  
Symposium on Foundations of Computer Science (FOCS), 2023. arXiv:2212.11191  
**Invited to SICOMP Special Issue.**

A DICTATORSHIP TEST WITH PERFECT COMPLETENESS FOR 2-TO-2 LABEL COVER  
**Brakensiek, J.** and Guruswami, V.

Chicago Journal of Theoretical Computer Science (CJTCS), 2023. ECCS TR17-141

IMPROVED FIELD SIZE BOUNDS FOR HIGHER ORDER MDS CODES

**Brakensiek, J.**, Dhar, M., and Gopi, S.

IEEE International Symposium on Information Theory (ISIT), 2023. arXiv:2212.11262

GENERIC REED-SOLOMON CODES ACHIEVE LIST-DECODING CAPACITY

**Brakensiek, J.**, Gopi, S., and Makam, V.

Symposium on Theory of Computing (STOC), 2023. arXiv:2206.05256

**Invited to SICOMP Special Issue.**

SDPs AND ROBUST SATISFIABILITY OF PROMISE CSP

**Brakensiek, J.**, Guruswami V., and Sandeep, S.

Symposium on Theory of Computing (STOC), 2023. arXiv:2211.08373

CONDITIONAL DICHOTOMY OF BOOLEAN ORDERED PROMISE CSPs

**Brakensiek, J.**, Guruswami V., and Sandeep, S.

TheoretCS, 2023. arXiv:2102.11854

Conference Version:

Intl. Colloquium on Automata, Languages, and Programming (ICALP) 2021.

LOWER BOUNDS FOR MAXIMALLY RECOVERABLE TENSOR CODES AND HIGHER ORDER  
MDS CODES

**Brakensiek, J.**, Gopi, S., and Makam V.

IEEE Transactions on Information Theory, 2022. arXiv:2107.10822

THE RESOLUTION OF KELLER'S CONJECTURE

**Brakensiek, J.**, Heule, M., Mackey, J., and Narváez, D.

Journal of Automated Reasoning (JAR), 2022. arXiv:1910.03740

**Special Issue.**

Conference Version:

International Joint Conference on Automated Reasoning (IJCAR), 2020

**Best Paper Award.**

CONSTRAINT SATISFACTION PROBLEMS WITH GLOBAL MODULAR CONSTRAINTS: ALGO-  
RITHMS AND HARDNESS VIA POLYNOMIAL REPRESENTATIONS

**Brakensiek, J.**, Gopi, S., and Guruswami, V.

SIAM Journal on Computing (SICOMP), 2022. arXiv:1902.04740

Conference Version:

Symposium on Theory of Computing (STOC), 2019.

THE QUEST FOR STRONG INAPPROXIMABILITY RESULTS WITH PERFECT COMPLETENESS

**Brakensiek, J.** and Guruswami, V.

ACM Transactions on Algorithms (TALG), 2021. ECCS TR17-80

Conference Version:

Intl. Workshop on Approximation Algorithms for Combinatorial Optimization Problems (APPROX) 2017.

PROMISE CONSTRAINT SATISFACTION:

ALGEBRAIC STRUCTURE AND A SYMMETRIC BOOLEAN DICHOTOMY

**Brakensiek, J.** and Guruswami, V.

SIAM Journal on Computing (SICOMP), 2021. arXiv:1704.01937

Conference Version:

Symposium on Discrete Algorithms (SODA), 2018.

ON THE MYSTERIES OF MAX NAE-SAT

**Brakensiek, J.**, Huang, N., Potechin, A., and Zwick, U.

Symposium on Discrete Algorithms (SODA), 2021. arXiv:2009.10677

THE POWER OF THE COMBINED BASIC LP AND AFFINE RELAXATION FOR PROMISE CSPs.

**Brakensiek, J.**, Guruswami, V., Wrochna, M., and Živný S.

SIAM Journal on Computing (SICOMP), 2020. arXiv:1907.04383

Conference version:

SYMMETRIC POLYMORPHISMS AND EFFICIENT DECIDABILITY OF PROMISE CSPs.

**Brakensiek, J.** and Guruswami, V.

Symposium on Discrete Algorithms (SODA), 2020.

SMOOTHED COMPLEXITY OF 2-PLAYER NASH EQUILIBRIA

Boodaghians, S., **Brakensiek, J.**, Hopkins, S., and Rubinfeld, A.

Symposium on Foundations of Computer Science (FOCS), 2020. arXiv:2007.10857

CODED TRACE RECONSTRUCTION IN A CONSTANT NUMBER OF TRACES.

**Brakensiek, J.**, Li, R., and Spang, B.

Symposium on Foundations of Computer Science (FOCS), 2020. arXiv:1908.03996

CONSTANT-FACTOR APPROXIMATION OF NEAR-LINEAR EDIT DISTANCE IN NEAR-LINEAR TIME.

**Brakensiek, J.** and Rubinfeld, A.

Symposium on Theory of Computing (STOC), 2020. arXiv:1904.05390

BRIDGING BETWEEN 0/1 AND LINEAR PROGRAMMING VIA RANDOM WALKS

**Brakensiek, J.** and Guruswami, V.

Symposium on Theory of Computing (STOC), 2019. arXiv:1904.04860

AN ALGORITHMIC BLEND OF LPs AND RING EQUATIONS FOR PROMISE CSPs

**Brakensiek, J.** and Guruswami, V.

Symposium on Discrete Algorithms (SODA), 2019. ECCO TR18-059

EFFICIENT LOW-REDUNDANCY CODES FOR CORRECTING MULTIPLE DELETIONS

**Brakensiek, J.**, Guruswami, V., and Zbarsky, S.

IEEE Transactions on Information Theory (ITIT), 2017. arXiv:1507.06175

Conference version:

Symposium on Discrete Algorithms (SODA) 2016.

VERTEX ISOPERIMETRY AND INDEPENDENT SET STABILITY FOR TENSOR POWERS OF CLIQUES

**Brakensiek, J.**

Intl. Workshop on Randomization and Computation (RANDOM), 2017. arXiv:1702.04432

NEW HARDNESS RESULTS FOR GRAPH AND HYPERGRAPH COLORINGS

**Brakensiek, J.** and Guruswami, V.

Computational Complexity Conference (CCC), 2016. ECCC TR16-029

EFFICIENT GEOMETRIC PROBABILITIES OF

MULTI-TRANSITING EXOPLANETARY SYSTEMS FROM CORBITS

**Brakensiek, J.**, and Ragozzine, D.

The Astrophysical Journal, 2016. arXiv:1602.07014, Open source CORBITS code.

### **Manuscripts**

KAPRANOV DEGREES

**Brakensiek, J.**, Eur, C., Larson, M., and Li, S. arXiv:2308.12285

A SIMPLE SUBLINEAR ALGORITHM FOR GAP EDIT DISTANCE

**Brakensiek, J.**, Charikar, M., and Rubinfeld, A. arXiv:2007.14368

BOUNDS ON THE SIZE OF SOUND MONOTONE SWITCHING

NETWORKS ACCEPTING PERMUTATION SETS OF DIRECTED TREES

**Brakensiek, J.**, and Potechin, A. arXiv:1301.3780

### **Other Writings**

AUTOMATED DESIGN OF ERROR-CORRECTING CODES PART 2

Theory Dish (Stanford's CS Theory Research Blog). Wordpress.

AUTOMATED DESIGN OF ERROR-CORRECTING CODES PART 1

Theory Dish (Stanford's CS Theory Research Blog). Wordpress.

### **Research Talks and Posters**

INTERNATIONAL SYMPOSIUM ON INFORMATION THEORY

Hybrid. June 2023.

DAGSTUHL SEMINAR 22201

Hybrid. May 2022. (two talks)

STANFORD TCS QUALIFICATION EXAM

Virtual. March 2021.

STANFORD THEORY LUNCH

Virtual. December 2020.

FOUNDATIONS OF COMPUTER SCIENCE

Virtual. October 2020.

MICROSOFT RESEARCH MLO SEMINAR (INVITED)

Virtual. September 2020.

CSP SEMINAR (INVITED)

Virtual. August 2020.

SYMPOSIUM ON THEORY OF COMPUTING

Virtual. June 2020.

SYMPOSIUM ON DISCRETE ALGORITHMS

Salt Lake City, Utah, January 2020.

ACO SEMINAR

Carnegie Mellon University, Pittsburgh, Pennsylvania, September 2019.

MICROSOFT RESEARCH

Redmond, Washington, July 2019.

SYMPOSIUM ON THEORY OF COMPUTING

Phoenix, Arizona, June 2019. (talk and poster)

STANFORD THEORY LUNCH

Stanford, California, January 2019.

SYMPOSIUM ON DISCRETE ALGORITHMS

San Diego, California, January 2019.

DAGSTUHL SEMINAR 18231

Schloss Dagstuhl, Wadern, Germany, June 2018

*Recipient of NSF Support Grant*

CMU THEORY LUNCH (INVITED TALK)

Carnegie Mellon University, Pittsburgh, Pennsylvania, January 2018.

AMS CONTRIBUTED PAPERS IN COMBINATORICS

Joint Mathematics Meetings, San Diego, California, January 2018

SYMPOSIUM ON DISCRETE ALGORITHMS

New Orleans, Louisiana, January 2018

APPROX/RANDOM CONFERENCE

Berkeley, California, August 2017 (two talks)

CONFERENCE ON COMPUTATIONAL COMPLEXITY

Tokyo, Japan, May/June 2016

MEETING OF THE MINDS UNDERGRADUATE POSTER SESSION

Carnegie Mellon University, Pittsburgh, Pennsylvania, May 2016

*Recipient of Early Research Award*

CMU THEORY LUNCH (INVITED TALK)

Carnegie Mellon University, Pittsburgh, Pennsylvania, January 2016.

SYMPOSIUM ON DISCRETE ALGORITHMS

Arlington, Virginia, January 2016.

CMU THEORY LUNCH  
Carnegie Mellon University, Pittsburgh, Pennsylvania, November 2015

PI MU EPSILON UNDERGRADUATE STUDENT PRESENTATIONS  
MAA MathFest, Hartford, Connecticut, August 2013  
*Recipient of Pi Mu Epsilon Student Presentation Award*

MAA UNDERGRADUATE POSTER SESSION  
Joint Mathematics Meetings, San Diego, California, January 2013  
*Recipient of Outstanding Presentation Award*

DIVISION OF PLANETARY SCIENCE POSTER SESSION  
Reno, Nevada, October 2012  
*Recipient of Hartmann Student Travel Grant*

RESEARCH SCIENCE INSTITUTE SYMPOSIUM  
MIT, Cambridge, Massachusetts, August 2012

**Research  
Awards**

FOCS 2023 SICOMP Special Issue Invitation, 2023  
STOC 2023 SICOMP Special Issue Invitation, 2023  
Microsoft Research PhD Fellowship, 2021  
IJCAR Best Paper Award co-winner, 2020  
IJCAR 2020 JAR Special Issue Invitation, 2020  
NSF Graduate Research Fellowship, 2018  
CRA Outstanding Undergraduate Researcher Award, 2018  
Goldwater Scholarship, 2016  
Davidson Fellow, 2013  
Top Five Awardee: Written Research, Research Science Institute, 2012

**Competition  
Awards**

Putnam Fellow (top 5 individual) and 1st place team, 2016  
8th place individual and 2nd place team, Putnam Competition, 2015  
10.5th place individual, Putnam Competition, 2014  
Two-time Gold Medalist: International Olympiad in Informatics, 2013-14  
Silver Medalist: International Mathematical Olympiad, 2014  
Samuel L. Greitzer/Murray S. Klamkin Award for Mathematical Excellence, 2014  
USA Mathematical Olympiad sole perfect scorer, 2014  
Akamai Foundation Scholarship, 2014  
USA Mathematical Olympiad Winner, 2012, 2014  
International Mathematical Olympiad invitee (declined), 2012  
Bronze Medalist: Romanian Masters of Mathematics, 2012

**Other  
Awards**

CMU Senior Leadership Recognition, 2018  
Phi Kappa Phi, 2018  
Phi Beta Kappa *early inductee*, 2017  
Knaster-McWilliams Scholar, 2014-18  
Pi Mu Epsilon, 2012

<b>Work Experience</b>	COURSE ASSISTANT	Spring 2021
	Course assistant for Stanford course CS 269I (Incentives in Computer Science) taught by Aviad Rubinfeld. <i>Recognized to be in top 5% of CAs.</i>	
	RESEARCH INTERN FOR MICROSOFT	Summer 2020
	Research in the algorithms group at Microsoft Research under the supervision of Sivakanth Gopi.	
	COURSE ASSISTANT	Spring 2019
	Course assistant for Stanford course CS 354 (Unfulfilled Algorithmic Fantasies) taught by Aviad Rubinfeld. <i>Recognized to be in top 5% of CAs.</i>	
	TEACHING ASSISTANT	Fall 2017
	Teaching assistant for CMU course 15-458/15-858 (Discrete Differential Geometry) taught by Keenan Crane.	
	RESEARCH ASSISTANT	2015–18
	Theoretical computer science research under Venkatesan Guruswami at CMU	
	MATHEMATICS OLYMPIAD GRADER	2014–17
	Graded exams which helped to decide the USA International Math Olympiad team	
	RESEARCH ASSISTANT	2015–16
	Astrostatistics research under Chad Schafer and Peter Freeman at CMU	
	TECHNICAL CONSULTANT FOR EXPIL, INC.	2014
	Web design	
<b>Other</b>	MCS COLLEGE COUNCIL	
	Undergraduate representative for 2017-18 academic year.	
	(SUB)REVIEWER/REFEREE	
	Conferences: ISIT 2019; ICALP 2019; FOCS 2019; ESA 2019; FSTTCS 2019; SODA 2020; ISIT 2020; ICALP 2020; CCC 2020; MFCS 2020; SODA 2021; APPROX 2021; ICALP 2021; ISIT 2021; MFCS 2021; STOC 2021; FOCS 2021; SODA 2022; CCC 2022; STOC 2022; ICALP 2022; FOCS 2023; ESA 2023; SODA 2024; STOC 2024	
	Journals: Journal of the ACM; IEEE Transactions on Information Theory; ACM Transactions on Algorithms; SIAM Journal on Computing; Theory of Computing; ACM Transactions on Computation Theory; Electronic Journal of Combinatorics; Theory of Computing Systems; Information and Computation; Complexity; Mathematical Reviews/MathSciNet	
	PHOTOGRAPHY	
	Photograph “Symphony of Architectural Geometry” selected as the 2013, Week 52 photo in the MAA Found Math column of the Mathematical Association of America. Also featured in the MAA’s 100th anniversary calendar.	