



*(b) At UBC*

Rank or Title	Date
Professor	July 1, 2020 - present
Canada Research Chair in Algorithm Design (Tier 2, 5 year renewal)	April 1, 2017 - March 31, 2022
Associate Professor	July 1, 2015 - June 30, 2020
Canada Research Chair in Algorithm Design (Tier 2, 5 year appointment)	April 1, 2012 - March 31, 2017
Assistant Professor	June 1, 2011 - June 30, 2015

**7. TEACHING***(a) Areas of special interest and accomplishments*

Computer science is a fast-paced field, and the course curricula need to be revised regularly to keep up with recent developments. My particular interests include algorithms, complexity, optimization, and connecting theory to applied areas such as machine learning.

*(b) Courses Taught at UBC*

Session	Course Number	Title	Scheduled Hours	Class Size
2019WT2	CPSC 320	Intermediate Algorithm Design and Analysis	6/week	341 (two sections)
2018WT2	CPSC 536J	Linear Algebra Problems	3/week	6
2018WT1	CPSC 421/501	Introduction to Theory of Computing	3/week	84
2018WT1	CPSC 531H	Machine Learning Theory	3/week	19
2016WT2	CPSC 536N	Algorithms That Matter	3/week	22
2016WT1	CPSC 421/501	Introduction to Theory of Computing	3/week	88
2016S	CPSC 320	Intermediate Algorithm Analysis and Design	7.5/week	111
2015S	CPSC 320	Intermediate Algorithm Analysis and Design	7.5/week	105
2014WT2	CPSC 536N	Randomized Algorithms	3/week	19
2014S	CPSC 221	Basic Data Structures and Algorithms	7.5/week	120
2013WT2	CPSC 531H	Machine Learning Theory	3/week	15
2013WT1	CPSC 421/501	Introduction to Theory of Computing	3/week	44
2012WT2	CPSC 536N	Sparse Approximations	3/week	7
2012WT1	CPSC 421/501	Introduction to Theory of Computing	3/week	43
2011WT2	CPSC 536N	Randomized Algorithms	3/week	12

*(c) Graduate Students Supervised*

Student Name	Program Type	Year		Principal Supervisor	Co-supervisor
		Start	Finish		
Victor Sanchez Portella	Ph.D.	2019		Nicholas Harvey	
Sikander Randhawa	Ph.D.	2019 <sup>1</sup>		Nicholas Harvey	
Yihan (Joey) Zhou	M.Sc.	2019		Nicholas Harvey	Mark Schmidt
Sikander Randhawa	M.Sc.	Jan. 2018	2019 <sup>1</sup>	Nicholas Harvey	
Alireza Zakeri Hosseinabadi	M.Sc. essay	2016	2016	Nicholas Harvey	
Chris Liaw	Ph.D.-track M.Sc.	2015	2020 <sup>1</sup>	Nicholas Harvey	
Rebecca McKnight	M.Sc.	2013	2015	Nicholas Harvey	
Zachary Drudi	M.Sc.	2012	2014	Nicholas Harvey	
Samira Samadi	M.Sc.	2012	2014	Nicholas Harvey	
Wai Shing (Isaac) Fung <sup>2</sup>	Ph.D.	2009	2011	Nicholas Harvey	

<sup>1</sup>This is an expected date.

<sup>2</sup>Isaac was my Ph.D. student at the University of Waterloo. He changed his principal supervisor to Jochen Könemann when I moved from Waterloo to UBC.

*(d) Continuing Education Activities*

- 2015 Distinguished Speaker**<sup>1</sup>, Institut d'Études Scientifiques de Cargèse. A 4-hour tutorial on low-stretch trees, matrix concentration and graph sparsification.
- 2015 Summer School Speaker**, Summer School on Polyhedral Combinatorics. A 3-hour tutorial titled *Approximating Submodular Functions*.
- 2014 Tutorial Speaker**, PIMS Summer School on Randomized Techniques for Combinatorial Algorithms. A 5-hour tutorial titled *Graph Sparsifiers and Random Matrices*.
- 2010 Tutorial Speaker**, University of Waterloo Combinatorics and Optimization Summer School. A 1.5-hour tutorial titled *Partitioning sets to decrease the diameter*.

<sup>1</sup> Also listed under Keynote Speeches at Conferences.

*(f) Other Supervision****Postdoctoral Fellows Supervised at UBC***

Student Name	Year		Supervisor(s)
	Start	Finish	
Abbas Mehrabian	June 2015	December 2016	Nicholas Harvey <sup>1</sup>

<sup>1</sup> The first 8 months were co-supervised with Petra Berenbrink at SFU.

***Undergraduate Students Supervised at UBC***

Student Name	Program Type	Year	
		Start	Finish
Laura Greenstreet	Honours Thesis	2019	2020
Emmanuel Sales	Honours Thesis	2019	2020
Chris Liaw	Undergraduate Summer Research Assistant	2015	2015
Keyulu Xu	Work Learn Undergraduate Research Award	2014	2014

<sup>1</sup>This is an expected date.

***Student Outcomes and Awards***

Student Name	Outcome
Sikander Randhawa	Vanier Graduate Fellowship (2020-24)
Victor Sanches Portella	UBC CS 4-year Fellowship (2019-23)
Sikander Randhawa	NSERC CGSM (2019-21)
Chris Liaw	NSERC PGSD (2017-20)
Chris Liaw	UBC CS 4-year Fellowship (2016-20)
Chris Liaw	NSERC CGSM (2016-18)
Rebecca McKnight	Now a software engineer at Amazon in Vancouver.
Keyulu Xu	Work Learn Undergraduate Research Award. Now a PhD student at MIT.
Zachary Drudi	Now a software engineer at Google.
Samira Samadi	Now a PhD student at Georgia Tech.

*(g) Courses Taught prior to coming to UBC*

Session	Institution	Course Number	Title	Scheduled Hours	Class Size
Winter 2011	University of Waterloo	CO 750	Randomized Algorithms	3/week	8
Fall 2010	University of Waterloo	CO 355	Mathematical Optimization	3/week	24
Winter 2010	University of Waterloo	CO 351	Network Flow Theory	3/week	20
Fall 2009	University of Waterloo	CO 355	Mathematical Optimization	3/week	11

## 8. SCHOLARLY AND PROFESSIONAL ACTIVITIES

### (a) Areas of special interest and accomplishments

My research spans a wide range of topics in algorithm design, from theoretical questions near the boundary of mathematics, to practical innovations that are used in commercial products.

**Combinatorial Optimization.** *Goal:* analyzing the computational complexity of foundational problems on graphs and other combinatorial objects. *Key contributions:* the fastest known algorithm for non-bipartite matching in dense non-bipartite graphs. *Impact:* 12 papers [C6, C15, C16, C18, C22, C23, C30, J9, J10, J13, J14, T7].

**Machine Learning Theory.** *Goal:* rigorous analysis and algorithm design for problems arising in machine learning. *Key contributions:* optimal sample complexity bounds for mixtures of Gaussians; optimal convergence for non-smooth gradient descent. *Impact:* 5 papers [C11, C14, O2, J4, C5, J3, C2, C1].

**Applications of Theory to Systems and Networking.** *Goal:* using modern algorithmic ideas to enable novel functionality in computer systems and networks. *Key contributions:* the first peer-to-peer system to incorporate locality into its structure; the only space-efficient method for estimating miss-ratio curves. *Impact:* 16 papers [C8, C9, C20, C21, C24, C25, C27, C29, C30, C31, C32, C33, J14, J15, J16, C8, T8, T9], 4 patents [P1, P3, P5, P6].

### (b) Research or equivalent grants (indicate under COMP whether grants were obtained competitively (C) or non-competitively (NC))

Agency	Title	Comp	\$/Year	Year(s)	PIs
Canada Research Chair	Algorithm Design	C	\$10,000	2017-2022	Nicholas Harvey
NSERC Discovery	Algorithms: Sparsification and Applications	C	\$38,000	2016-2021	Nicholas Harvey
PIMS CRG	Algorithmic Theory of Networks <sup>1</sup>	C	\$40,000	2012-2015	Berenbrink, Ergun, King
NSERC Discovery	Combinatorial optimization and communication networks	C	\$29,000	2009-2015	Nicholas Harvey
Alfred P. Sloan Foundation <sup>2</sup>		C	\$25,000	2013-2015	Nicholas Harvey
UBC Startup		NC	\$80,000	2011	Nicholas Harvey

<sup>1</sup> This funding is for a collaborative research group that spans many universities. Nicholas Harvey is one of 8 co-organizers, to whom no funds are directly allocated.

<sup>2</sup> Also listed under Awards for Scholarship.

### (c) Invited Presentations

Invited tutorials are instead listed in Section 7(d), and keynote addresses in Section 8(d).

Intl Venue	Location	Event
2019		
CanaDAM University of Washington	Vancouver, BC Seattle, WA	Session on "Graph Polynomials" Theory Colloquium
2017		
UBC	Vancouver, BC	Math Dept Colloquium
2016		
1QBit	Vancouver, BC	Symposium on Mathematical Programming and Quantum Optimization
2015		
UBC	Vancouver, BC	Probability Seminar
UBC	Vancouver, BC	Discrete Math Seminar
Microsoft Research	Redmond, WA	Theory Seminar
University of Washington	Seattle, WA	Theory Seminar
École Polytechnique Fédérale de Lausanne	Lausanne, Switzerland	Theory Seminar
Intl. Symposium on Math. Programming	Pittsburgh, PA	Session on "The Lovász Local Lemma"
McGill Bellairs Research Institute	Barbados	Workshop on Combinatorial Optimization
Mathematical Sciences Research Institute	Berkeley, CA	Workshop on "Kadison-Singer, Interlacing Polynomials, and Beyond"
Mathematical Sciences Research Institute	Berkeley, CA	Workshop on "Kadison-Singer, Interlacing Polynomials, and Beyond"
AMS-MAA Joint Mathematics Meetings	San Antonio, TX	Session on "Concentration Inequalities for Random Matrices: Theory and Applications"
2014		
Microsoft Research	Redmond, WA	Theory Group Seminar
National Institute of Informatics	Shonan, Japan	Workshop on Algorithms for Large Scale Graphs
University of Chicago	Chicago, IL	CS Theory Seminar
2013		
Microsoft Research	Redmond, WA	Theory Group Seminar
McGill Bellairs Research Institute	Barbados	Workshop on Approximation Algorithms
University of Victoria	Victoria, BC	Pacific Northwest Theory Day
University of Warsaw	Warsaw, Poland	Algorithms Seminar
University of Alberta	Edmonton, AB	Functional Analysis Seminar
2012		
IEEE FOCS Workshop	New Brunswick, NJ	Randomized Numerical Linear Algebra: Theory and Practice
Simon Fraser University	Burnaby, BC	Discrete Math Seminar
UBC	Vancouver, BC	Operations and Logistics Seminar
Intl. Symposium on Math. Programming	Berlin, Germany	Session on "Flows, Cuts and Sparsifiers"
2011		
UBC	Vancouver, BC	Scientific Comp. and Applied & Indust. Math. Seminar
University of Washington	Seattle, WA	Computer Science Theory Seminar
Georgia Institute of Technology	Atlanta, GA	Algorithms and Randomness Center Seminar
Carnegie Mellon University	Pittsburgh, PA	School of Computer Science Theory Seminar
University of British Columbia	Vancouver, BC	Theory Seminar

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Google Research	New York, NY	Theory Seminar
Institute for Advanced Study	Princeton, NJ	Mathematics Seminar
McGill Bellairs Research Institute	Barbados	Workshop on Approximation Algorithms
University of Michigan	Ann Arbor, MI	Computer Science Theory Seminar
2010		
Inst. for Pure and Applied Math.	Los Angeles, CA	Modern Trends in Optimization and Its Application
University of Waterloo	Waterloo, ON	Tutte Seminar
Research Inst. for Math. Sciences	Kyoto, Japan	Discrete Optimization Seminar
SIAM Discrete Math Conference	Austin, TX	Minisymposium on Submodular Functions
McGill Bellairs Research Institute	Barbados	Workshop on Approximation Algorithms
University of Waterloo	Waterloo, ON	Computer Science Club
2009		
University of Buffalo	Buffalo, NY	Eastern Great Lakes Theory Workshop
Institute for Advanced Study	Princeton, NJ	Mathematics Seminar
2008		
Research Inst. for Math. Sciences	Kyoto, Japan	Workshop on Combinatorial Optimization and Discrete Algorithms
IEEE Information Theory Workshop	Porto, Portugal	Invited Session on Computer Science
2007		
Georgia Institute of Technology	Atlanta, GA	ACO Seminar
Carnegie Mellon University	Pittsburgh, PA	Theory/Operations Research Seminar
Tsinghua University	Beijing, China	China Theory Week
Brown University	Providence, RI	Computer Science Theory Seminar
Yale University	New Haven, CT	Cowles Foundation Workshop on Optimization
2006		
Dartmouth University	Hanover, NH	Computer Science Theory Seminar
Stanford University	Palo Alto, CA	Algorithms Seminar
Lucent Bell Labs	New Providence, NJ	Math. and Algorithmic Sciences Research Center
Research Inst. for Math. Sciences	Kyoto, Japan	Discrete Optimization Seminar
Princeton University	Princeton, NJ	Department of Computer Science
Intl. Symposium on Math. Programming	Rio de Janeiro, Brazil	Graphs and Matroids Session
Amazon.com	Seattle, WA	Algorithms Seminar
University of Waterloo	Waterloo, ON	Combinatorics and Optimization Seminar
IBM T.J. Watson Research Center	Yorktown Heights, NY	Algorithms and Theory Group
2005		
Princeton University	Princeton, NJ	Workshop on Flexible Network Design
Tokyo University	Tokyo, Japan	Department of Mathematical Engineering Seminar
Kyoto University	Kyoto, Japan	School of Informatics
University of Illinois	Urbana-Champaign, IL	Allerton Conference
Microsoft Research	Seattle, WA	Theory Group Seminar
2003		
University of Washington	Seattle, WA	Computer Science Theory Seminar
ICSI Center for Internet Research (ICIR)	Berkeley, CA	Networking Seminar

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(d) *Conference Participation (Organizer, Keynote Speaker, etc.)*

### **Conference Organization**

Year	Venue	Title
2017	Simons Institute	Bridging Continuous and Discrete Optimization

### **Workshop Organization**

Year	Venue	Title
2017	UBC Dept. of Computer Science	Theory at UBC Mini-Symposium
2016	Banff International Research Station	Algebraic and Spectral Graph Theory
2015	International Symposium on Mathematical Programming	Session on the Lovász Local Lemma
2015	Bellairs Research Institute	Discrepancy and Modern Rounding
2015	Banff International Research Station	Towards a Unified Treatment of Dynamic Graphs
2013	IEEE Symposium on Foundations of Computer Science	Zeros of Polynomials and their Applications to Theory

### **Keynote Speeches at Conferences**

Year	Title	Venue	Event
2015	Distinguished Speaker	Institut d'Études Scientifiques de Cargèse	Sixth Workshop on Combinatorial Optimization
2013	Plenary Speaker	Fields Institute	6th Workshop on Flexible Network Design

## **9. SERVICE TO THE COMMUNITY**

(a) *Memberships on scholarly societies, including offices held and dates*

(b) *Memberships on other societies, including offices held and dates*

(c) *Memberships on scholarly committees, including offices held and dates*

(d) *Memberships on other committees, including offices held and dates*

(e) *Editorships (list journal and dates)*

Journal	Position	Years
SIAM Journal on Computing	Associate Editor	2017-2020
ACM Transactions on Algorithms	Associate Editor	2015-2021

(f) *Reviewer (journal, agency, etc., including dates)*

### **Program Committees**

In top-tier conferences in theoretical computer science, the program committee members typically manage 40 papers, solicit reviews from subreviewers, moderate discussions, and recommend acceptance or rejection for each paper. Serving on the program committee for FOCS, SODA, etc., is a prestigious position, analogous to serving on a journal's editorial board.

Year	Conference Name
2017	ACM Symposium on the Theory of Computation (STOC)
2017	Canadian Discrete and Algorithmic Mathematics Conference (CanaDAM)
2016	ACM-SIAM Symposium on Discrete Algorithms (SODA)
2015	International Workshop on Randomization and Computation (RANDOM)

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2013 Theory and Applications of Models of Computation (TAMC)  
2013 ACM-SIAM Symposium on Discrete Algorithms (SODA)  
2010 IEEE Symposium on Foundations of Computer Science (FOCS)

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### *Journal Reviews*

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ACM Transactions on Algorithms  
American Mathematical Monthly  
Combinatorics, Probability and Computing  
Discrete Applied Mathematics  
Discrete Mathematics  
Foundations and Trends in Theoretical Computer Science  
Geometric and Functional Analysis  
IEEE/ACM Transactions on Networking  
IEEE Communications Letters  
IEEE Transactions on Information Theory  
IEEE Transactions on Parallel and Distributed Systems  
Information and Computation  
International Mathematics Research Notices  
Journal of the ACM  
Journal of Algorithms  
Mathematics of Operations Research  
SIAM Journal on Computing  
SIAM Journal on Discrete Mathematics  
SIAM Journal on Matrix Analysis and Applications  
Telecommunication Systems  
Theoretical Computer Science  
Theory of Computation

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### *Conference Reviews*

I have reviewed papers for various conferences, typically 1 or 2 papers per conference.

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ACM-SIAM Symposium on Discrete Algorithms  
ACM SIGACT-SIGOPS Symposium on Principles of Distributed Computing  
ACM Symposium on Parallelism in Algorithms and Architectures  
ACM Symposium on Theoretical Computer Science  
Conference on Integer Programming and Combinatorial Optimization  
Data Compression Conference  
European Symposium on Algorithms  
IEEE Conference on Computational Complexity  
IEEE International Parallel & Distributed Processing Symposium  
IEEE International Symposium on High Performance Distributed Computing  
IEEE Symposium on Foundations of Computer Science  
IEEE Symposium on Information Theory  
Integer Programming and Combinatorial Optimization  
International Conference on Automata, Languages and Programming  
International Conference on Machine Learning  
International Symposium on Mathematical Foundations of Computer Science  
Latin American Theoretical Informatics Symposium

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**Grant Reviews** I have reviewed grants for the Israel Science Foundation under the Individual Research Grant program.

(g) *External examiner (indicate universities and dates)*

University	Degree	Supervisor	Student	Date
Simon Fraser University	Ph.D.	Petra Berenbrink	Hoda Akbari	November 20, 2014

**University Examiner (at UBC)**

Department	Degree	Supervisor	Student	Date
Mathematics	Ph.D.	Michael Bennett	Adela Gherga	October 16, 2019
ECE	Ph.D.	Sathish Gopalakrishnan	Bader Alahmad	April 10, 2019
Mathematics	Ph.D.	Omer Angel	Tom Hutchcroft	July 16, 2017
Mathematics	Ph.D.	Brian Marcus	Raimundo Briceno Dominguez	July 22, 2016
Mathematics	Ph.D.	Akos Magyar	Tatchai Titichetrakun	April 14, 2016
Computer Science	Ph.D.	Joel Friedman	Alice Izsak	November 19, 2015
Computer Science	Ph.D.	Uri Ascher	Farbod Roosta-Khorasani	March 27, 2015
Mathematics	Ph.D.	Malabika Pramanik	Edward Kroc	March 20, 2015

(h) *Consultant (indicate organization and dates)*

Company	Role	Year		Description
		Start	Finish	
Microsoft Research	Consulting researcher	2017	2017	Research in the theory and database groups.
Microsoft Research	Consulting researcher	2015	2015	Research in the theory group.
Coho Data, Inc.	Algorithm consultant	2013	2015	A Vancouver-based startup company developing high-performance enterprise storage.

(i) *Other service to the community*

## 10. AWARDS AND DISTINCTIONS

(a) *Awards for Teaching (indicate name of award, awarding organizations and date)*

- UBC Computer Science Department Teaching Award, 2019.
- UBC Computer Science Department Teaching Award, 2014.
- UBC Computer Science Department Teaching Award, 2012.

(b) *Awards for Scholarship (indicate name of award, awarding organizations and date)*

- NeurIPS Best Paper Award, 2018. Awarded to 4 out of 4854 submissions to the Conference on Neural Information Processing Systems.
- Canada Research Chair (Tier 2) in Algorithm Design, renewed April 2017. This award brings \$500,000 to UBC over five years.
- CS-Can/Info-Can Outstanding Young Computer Science Researcher prize, 2016.
- Alfred P. Sloan Research Fellowship, 2013. Also listed under competitive research grants.
- Canada Research Chair (Tier 2) in Algorithm Design, April 2012. This award brings \$500,000 to UBC over five years.

- Best Student Paper Award (“Machtey Award”), 2006. Awarded annually to the best paper authored by a student at IEEE Symposium on Foundations of Computer Science.
- USITS Best Paper Award, 2003. Awarded annually to the best paper at the USENIX Symposium on Internet Technologies and Systems.

*(d) Other Awards: Student Scholarships*

- NSERC Post Graduate Scholarship PGS-D, 2005, For Tenure Abroad.
- NSERC Canada Graduate Scholarship, 2005. (Declined).
- NSERC Canada Graduate Scholarship, 2004. (Declined).
- MIT Presidential Graduate Fellowship, 2003-04.
- NSERC Post Graduate Scholarship PGS-M, 2000, For Tenure Abroad. (Declined).
- Combinatorics and Optimization Book Prize, University of Waterloo, 2000. Awarded annually to an outstanding student in the Combinatorics and Optimization department.
- René Descartes Entrance Scholarship, University of Waterloo, 1995.

THE UNIVERSITY OF BRITISH COLUMBIA  
*Publication Record*

SURNAME: Harvey

Date: July 2, 2020

FIRST NAME: Nicholas

MIDDLE NAME: James Alexander

## 1. REFEREED PUBLICATIONS

(a) *Archival, Rigorously Refereed Conference Proceedings*

- [C1] **Huang Fang**, Nicholas J. A. Harvey, **Victor S. Portella**, and Michael P. Friedlander. Online mirror descent and dual averaging: keeping pace in the dynamic case. In *International Conference on Machine Learning (ICML)*, July 2020.
- [C2] Nicholas J. A. Harvey, **Christopher Liaw**, Yaniv Plan, and **Sikander Randhawa**. Tight analyses for non-smooth stochastic gradient descent. In Alina Beygelzimer and Daniel Hsu, editors, *Proceedings of the Thirty-Second Conference on Learning Theory (COLT)*, volume 99 of *Proceedings of Machine Learning Research*, pages 1579–1613, Phoenix, USA, June 2019. Acceptance rate 33% = 118/361. Conference version of [T1].
- [C3] Hassan Ashtiani, Shai Ben-David, Nicholas Harvey, **Christopher Liaw**, Abbas Mehrabian, and Yaniv Plan. Nearly tight sample complexity bounds for learning mixtures of Gaussians via sample compression schemes. In S. Bengio, H. Wallach, H. Larochelle, K. Grauman, N. Cesa-Bianchi, and R. Garnett, editors, *Advances in Neural Information Processing Systems (NeurIPS) 31*, pages 3412–3421. Curran Associates, Inc., December 2018. Accepted for **oral presentation**. This is a very prestigious outcome, awarded to 0.6% of submissions (30 out of approximately 4854). Conference version of [S2].
- [C4] Nicholas J. A. Harvey, **Christopher Liaw**, and **Paul Liu**. Greedy and local ratio algorithms in the MapReduce model. In *ACM Symposium on Parallelism in Algorithms and Architectures (SPAA)*, pages 43–52, July 2018. Acceptance rate for regular papers 24% = 31/127.
- [C5] Nicholas J. A. Harvey, Piyush Srivastava, and Jan Vondrák. Computing the independence polynomial: from the tree threshold down to the roots. In *ACM-SIAM Symposium on Discrete Algorithms (SODA)*, pages 1557–1576, January 2018. Acceptance rate 32% = 180/547. Conference version of [T3].
- [C6] Nick Harvey, **Christopher Liaw**, and **Abbas Mehrabian**. Nearly-tight VC-dimension bounds for piecewise linear neural networks. In Satyen Kale and Ohad Shamir, editors, *Proceedings of the 2017 Conference on Learning Theory*, volume 65 of *Proceedings of Machine Learning Research*, pages 1064–1068, Amsterdam, Netherlands, 07–10 Jul 2017. Acceptance rate 32% = 74/228. Conference version of [J3].
- [C7] Nicholas J. A. Harvey and **Keyulu Xu**. Generating random spanning trees via fast matrix multiplication. In *Proceedings of the Latin American Theoretical Informatics Symposium (LATIN)*, April 2016. Acceptance rate 40% = 52/131.
- [C8] Nicholas J. A. Harvey and Jan Vondrák. An algorithmic proof of the Lovász local lemma via resampling oracles. In *IEEE Symposium on Foundations of Computer Science (FOCS)*, October 2015. Acceptance rate 27% = 86/314. Conference version of [J1] and [T4].

- [C9] **Zachary Drudi**, Nicholas J. A. Harvey, Stephen Ingram, Andrew Warfield, and Jake Wires. Approximating miss ratio curves using streaming algorithms. In *17th International Workshop on Approximation Algorithms for Combinatorial Optimization Problems (APPROX)*, August 2015. Acceptance rate 42% = 26/61. Related to patent [P1].
- [C10] Jake Wires, Stephen Ingram, **Zachary Drudi**, Nicholas J. A. Harvey, and Andrew Warfield. Characterizing storage workloads with counter stacks. In *11th USENIX Symposium on Operating Systems Design and Implementation (OSDI)*, October 2014. Acceptance rate 18% = 42/228. Related to patent [P1] and article [O1].
- [C11] Nicholas J. A. Harvey, Roy Schwartz, and Mohit Singh. Discrepancy without partial coloring. In *17th International Workshop on Approximation Algorithms for Combinatorial Optimization Problems (APPROX)*, September 2014. Acceptance rate 48% = 31/64.
- [C12] Nicholas J. A. Harvey and **Samira Samadi**. Near-optimal herding. In *Conference on Learning Theory (COLT)*, June 2014. Acceptance rate 28% = 38/136.
- [C13] Nicholas J. A. Harvey and Neil Olver. Pipage rounding, pessimistic estimators, and matrix concentration. In *ACM-SIAM Symposium on Discrete Algorithms (SODA)*, January 2014. Acceptance rate 28% = 136/485.
- [C14] **Wai Shing Fung**, Ramesh Hariharan, Nicholas J. A. Harvey, and Debmalya Panigrahi. A general framework for graph sparsification. In *ACM Symposium on Theory of Computing (STOC)*, June 2011. Acceptance rate 28% = 84/304. Conference version of [J2].
- [C15] Maria-Florina Balcan and Nicholas J. A. Harvey. Learning submodular functions. In *ACM Symposium on Theory of Computing (STOC)*, June 2011. Acceptance rate 28% = 84/304. Conference version of [J4].
- [C16] Michel X. Goemans, Nicholas J. A. Harvey, Satoru Iwata, and Vahab Mirrokni. Approximating submodular functions everywhere. In *ACM-SIAM Symposium on Discrete Algorithms (SODA)*, January 2009. Acceptance rate 29% = 135/458.
- [C17] Takehiro Ito, Erik D. Demaine, Nicholas J. A. Harvey, Christos H. Papadimitriou, Martha Sideri, Ryuhei Uehara, and Yushi Uno. On the complexity of reconfiguration problems. In *International Symposium on Algorithms and Computation (ISAAC)*, December 2008. Acceptance rate 34% = 78/229. Conference version of [J11].
- [C18] Nicholas J. A. Harvey, Jelani Nelson, and Krzysztof Onak. Sketching and streaming entropy via approximation theory. In *IEEE Symposium on Foundations of Computer Science (FOCS)*, October 2008. Acceptance rate 29% = 79/276. Conference version of [O3].
- [C19] Nicholas J. A. Harvey. Matroid intersection, pointer chasing, and Young’s seminormal representation of  $S_n$ . In *ACM-SIAM Symposium on Discrete Algorithms (SODA)*, January 2008. Acceptance rate 30% = 135/455.
- [C20] John Dunagan and Nicholas J. A. Harvey. Iteratively constructing preconditioners via the conjugate gradient method. In *ACM Symposium on Theory of Computing (STOC)*, June 2007. Acceptance rate 25% = 78/312.
- [C21] Nicholas J. A. Harvey, Robert D. Kleinberg, Chandra Nair, and Yunnan Wu. A “chicken & egg” network coding problem. In *IEEE International Symposium on Information Theory (ISIT)*, June 2007. Acceptance rate 61% = 603/993.
- [C22] Nicholas J. A. Harvey, Mihai Pătraşcu, Yonggang Wen, Sergey Yekhanin, and Vincent W. S. Chan. Non-adaptive fault diagnosis for all-optical networks via combinatorial

- group testing on graphs. In *IEEE Conference on Computer Communications (INFOCOM)*, May 2007. Acceptance rate  $18\% \approx 250/1400$ .
- [C23] Nicholas J. A. Harvey. An algebraic algorithm for weighted linear matroid intersection. In *ACM-SIAM Symposium on Discrete Algorithms (SODA)*, January 2007. Acceptance rate  $36\% = 139/382$ .
- [C24] Nicholas J. A. Harvey. Algebraic structures and algorithms for matroid and matching problems. In *IEEE Symposium on Foundations of Computer Science (FOCS)*, October 2006. Acceptance rate  $29\% = 71/243$ . Conference version of [J13].
- [C25] Micah Adler, Erik D. Demaine, Nicholas J. A. Harvey, and Mihai Pătrașcu. Lower bounds for asymmetric communication channels and distributed source coding. In *ACM-SIAM Symposium on Discrete Algorithms (SODA)*, January 2006. Acceptance rate  $31\% = 135/440$ .
- [C26] Micah Adler, Nicholas J. A. Harvey, Kamal Jain, Robert D. Kleinberg, and April R. Lehman. On the capacity of information networks. In *ACM-SIAM Symposium on Discrete Algorithms (SODA)*, January 2006. Acceptance rate  $31\% = 135/440$ . Conference version of [J15].
- [C27] Nicholas J. A. Harvey, David R. Karger, and Sergey Yekhanin. The complexity of matrix completion. In *ACM-SIAM Symposium on Discrete Algorithms (SODA)*, January 2006. Acceptance rate  $31\% = 135/440$ .
- [C28] Nicholas J. A. Harvey, David R. Karger, and Kazuo Murota. Deterministic network coding by matrix completion. In *ACM-SIAM Symposium on Discrete Algorithms (SODA)*, January 2005. Acceptance rate  $28\% = 135/488$ .
- [C29] John Dunagan, Nicholas J. A. Harvey, Michael B. Jones, Dejan Kostić, Marvin Theimer, and Alec Wolman. FUSE: Lightweight guaranteed distributed failure notification. In *Symposium on Operating System Design and Implementation (OSDI)*, December 2004. Acceptance rate  $14\% = 27/193$ . Related to patent [P4].
- [C30] Kevin Zatloukal and Nicholas J. A. Harvey. Family Trees: An ordered dictionary with optimal congestion, locality, degree, and search time. In *ACM-SIAM Symposium on Discrete Algorithms (SODA)*, January 2004. Acceptance rate  $30\% = 135/455$ .
- [C31] Nicholas J. A. Harvey, László Lovász, Richard Ladner, and Tami Tamir. Semi-matchings for bipartite graphs and load balancing. In Frank K. H. A. Dehne, Jörg-Rüdiger Sack, and Michiel H. M. Smid, editors, *Algorithms and Data Structures, 8th International Workshop (WADS)*, volume 2748 of LNCS. Springer, July 2003. Conference version of [J14]. Related to patent [P5].
- [C32] Nicholas J. A. Harvey and J. Ian Munro. Deterministic SkipNet. In *ACM Symposium on Principles of Distributed Computing (PODC)*, July 2003. Conference version of [J16].
- [C33] Nicholas J. A. Harvey, Michael B. Jones, Stefan Saroiu, Marvin Theimer, and Alec Wolman. SkipNet: A scalable overlay network with practical locality properties. In *USENIX Symposium on Internet Technologies and Systems (USITS)*, March 2003. Acceptance rate  $28\% = 21/76$ . Related to patent [P3] and technical report [T9].
- [C34] Nicholas J. A. Harvey, Michael B. Jones, Marvin Theimer, and Alec Wolman. Efficient recovery from organizational disconnects in SkipNet. In Frans Kaashoek and Ion Stoica, editors, *Peer-to-Peer Systems II: Second International Workshop (IPTPS)*, volume 2735 of LNCS, pages 183–196. Springer, February 2003. Acceptance rate  $16\% = 27/166$ .

(b) *Refereed Journals*

- [J1] Hassan Ashtiani, Shai Ben-David, Nicholas J. A. Harvey, **Christopher Liaw**, Abbas Mehrabian, and Yaniv Plan. Near-optimal sample complexity bounds for robust learning of Gaussians mixtures via compression schemes. *Journal of the ACM*. 37 pages. Journal version of [C2].
- [J2] Nicholas J. A. Harvey and Jan Vondrák. An algorithmic proof of the Lovász local lemma via resampling oracles. *SIAM Journal on Computing*. 34 pages. Journal version of [C7] and [T4].
- [J3] **Wai Shing Fung**, Ramesh Hariharan, Nicholas J. A. Harvey, and Debmalya Panigrahi. A general framework for graph sparsification. *SIAM Journal on Computing*, 48(4):1196–1223, 2019. Submitted August 2016. Accepted on July 26, 2019. Journal version of [C13].
- [J4] Peter Bartlett, Nicholas J. A. Harvey, **Chris Liaw**, and **Abbas Mehrabian**. Nearly-tight VC-dimension bounds for piecewise linear neural networks. *Journal of Machine Learning Research*, 20(63):1–17, 2019. Journal version of [C5].
- [J5] Maria-Florina Balcan and Nicholas J. A. Harvey. Submodular functions: Learnability, structure, and optimization. *SIAM Journal on Computing*, 47(3):703–754, 2018. Journal version of [C14].
- [J6] Nicholas J. A. Harvey and **Christopher Liaw**. Rainbow hamilton cycles and lopsidedependency. *Discrete Mathematics*, 340(6):1261–1270, 2017.
- [J7] **Marcel de Carli Silva**, Nicholas J. A. Harvey, and **Cristiane Sato**. Sparse sums of positive semi-definite matrices. *ACM Transactions on Algorithms*, 12(1):9:1–9:17, December 2015.
- [J8] Nicholas J. A. Harvey. A note on the discrepancy of matrices with bounded row and column sums. *Discrete Mathematics*, 338:517–521, April 2015.
- [J9] Nicholas J. A. Harvey. A generalization of the Cauchy-Schwarz inequality involving four vectors. *Journal of Mathematical Inequalities*, 9(2):489–491, June 2015.
- [J10] Erik D Demaine, Martin L Demaine, Nicholas J. A. Harvey, Ryuhei Uehara, Takeaki Uno, and Yushi Uno. UNO is hard, even for a single player. *Theoretical Computer Science*, 521:51–61, February 2014.
- [J11] Nicholas J. A. Harvey, Tamás Király, and Lap Chi Lau. On disjoint common bases in two matroids. *SIAM Journal on Discrete Mathematics*, 25(4):1792–1803, 2011.
- [J12] Takehiro Ito, Erik D. Demaine, Nicholas J. A. Harvey, Christos H. Papadimitriou, Martha Sideri, Ryuhei Uehara, and Yushi Uno. On the complexity of reconfiguration problems. *Theoretical Computer Science*, 412(12-14):1054–1065, 2011. Journal version of [C16].
- [J13] Nicholas J. A. Harvey. Query lower bounds for matroid intersection. *RIMS Kokyuroku Bessatsu*, 23:81–105, 2010.
- [J14] Nicholas J. A. Harvey. Algebraic algorithms for matroid and matching problems. *SIAM Journal on Computing*, 39(2):679–702, 2009. Journal version of [C23].
- [J15] Nicholas J. A. Harvey, László Lovász, Richard Ladner, and Tami Tamir. Semi-matchings for bipartite graphs and load balancing. *Journal of Algorithms*, 59(1):53–78, 2006. Journal version of [C30]. Related to patent [P5].
- [J16] Nicholas J. A. Harvey, Robert D. Kleinberg, and April R. Lehman. On the capacity of information networks. *IEEE Transactions on Information Theory*, 52(6):2345–2364, 2006. Journal version of [C25].
- [J17] Nicholas J. A. Harvey and J. Ian Munro. Deterministic SkipNet. *Information Processing Letters*, 90(4):205–208, 2004. Journal version of [C31].

(c) *Other: Nonarchival and/or Less Rigorously Refereed Publications*

- [O1] Jake Wires, Stephen Ingram, **Zachary Drudi**, Nicholas J. A. Harvey, and Andrew Warfield. Counter stacks and the elusive working set. *login: the Usenix magazine*, 40(1), February 2015.
- [O2] Maria-Florina Balcan, Nicholas J. A. Harvey, and Satoru Iwata. Learning symmetric non-monotone submodular functions. In *NIPS Workshop on Discrete Optimization in Machine Learning*, December 2012.
- [O3] Nicholas J. A. Harvey, Jelani Nelson, and Krzysztof Onak. Streaming algorithms for estimating entropy. In *IEEE Information Theory Workshop (ITW)*, May 2008. Preliminary version of [C17].
- [O4] Petar Maymounkov, Nicholas J. A. Harvey, and Desmond Lun. Methods for efficient network coding. In *Allerton Conference on Communication, Control, and Computing*, September 2006.
- [O5] Nicholas J. A. Harvey, Kamal Jain, Lap Chi Lau, Chandra Nair, and Yunnan Wu. Conservative network coding. In *Allerton Conference on Communication, Control, and Computing*, September 2006.
- [O6] Nicholas J. A. Harvey and Robert Kleinberg. Tighter cut-based bounds for  $k$ -pairs communication problems. In *Allerton Conference on Communication, Control, and Computing*, September 2005.
- [O7] Nicholas J. A. Harvey and Kevin Zatloukal. The post-order heap. In *International Conference on Fun with Algorithms (FUN)*, May 2004.

## 2. NON-REFEREED PUBLICATIONS

(a) *Other: Technical Reports*

- [T1] Nicholas J. A. Harvey, **Christopher Liaw**, Yaniv Plan, and **Sikander Randhawa**. Tight analyses for non-smooth stochastic gradient descent. arxiv:1812.05217. 39 pages. Submitted December 2018. Extended version of [C1].
- [T2] Nicholas J. A. Harvey and Jan Vondrák. Short proofs for generalizations of the Lovász Local Lemma: Shearer’s condition and cluster expansion. arXiv:1711.06797. 7 pages. Submitted November 2017.
- [T3] Nicholas J. A. Harvey, Piyush Srivastava, and Jan Vondrák. Computing the independence polynomial in Shearer’s region for the LLL. arXiv:1608.02282. 35 pages. Submitted August 2016. Extended version of [C4].
- [T4] Nicholas J. A. Harvey and Jan Vondrák. An algorithmic proof of the Lovász local lemma via resampling oracles. arXiv:1504.02044 [cs.DS]. 47 pages. Submitted November 2015. Extended version of [C7] and [J1].
- [T5] Nicholas J. A. Harvey. An introduction to the Kadison-Singer problem and the paving conjecture. Technical report, 2013.
- [T6] **Wai Shing Fung** and Nicholas J. A. Harvey. Graph sparsification by edge-connectivity and random spanning trees. arXiv:0909.0941 [cs.DS], 2010. Related to conference publication [C13].
- [T7] Michel X. Goemans, Nicholas J. A. Harvey, Kamal Jain, and Mohit Singh. A randomized rounding algorithm for the asymmetric traveling salesman problem. arXiv:0909.0941 [cs.DS], 2009.

- [T8] Nicholas J. A. Harvey, Robert D. Kleinberg, and April R. Lehman. Comparing network coding with multicommodity flow for the  $k$ -pairs communication problem. Technical Report MIT-LCS-TR-964, 2004.
- [T9] John Dunagan, Nicholas J. A. Harvey, Michael B. Jones, Stefan Saroiu, Marvin Theimer, and Alec Wolman. SkipNet: A scalable overlay network with practical locality properties. Microsoft Technical Report MSR-TR-2002-92, 2002. Related to publications [C32, C33] and patent [P3].

### 3. PATENTS

- [P1] **Zachary Drudi**, Nicholas J. A. Harvey, Stephen Ingram, Andrew Warfield, and Jake Wires. Systems, methods, and devices for determining locality in data stream and conversions thereof. Provisional application #61/987,234 filed May 1, 2014. Related to publications [C8, C9].
- [P2] Jeffrey B. Parham, Levon A. Esibov, Nicholas J. Harvey, and William B. Lees. Generalized proximity service. US Patents 8,145,699 (March 27, 2012) and 8,250,220 (August 21, 2012).
- [P3] Nicholas J. Harvey, Michael B. Jones, Stefan Saroiu, Marvin M. Theimer, Alastair Wolman, and Atul Adya. System and method for creating improved overlay network with an efficient distributed data structure. US Patent 7,613,796 (November 3, 2009) and European Patent 1398924 (June 25, 2008). Related to publication [C32] and technical report [T9].
- [P4] John Dunagan, Nicholas J. A. Harvey, Michael B. Jones, Dejan Kostić, Marvin M. Theimer, and Alec Wolman. Method for providing guaranteed distributed failure notification. US Patent 7,551,552 (June 23, 2009). Related to publication [C28].
- [P5] Nicholas Harvey and László Lovász. Method and system for matching network clients and servers under matching constraints. US Patent 7,165,103 (January 16, 2007). Related to publications [C30, J14].
- [P6] Jeffrey B. Parham, Mark R. Brown, William B. Lees, Van H. Vu, László Lovász, Nicholas J. A. Harvey, and Katalin Vesztergombi. Method for designating communication paths in a network. US Patents 6,879,564 (April 12, 2005) and 7,499,413 (March 3, 2009).
- [P7] John Dunagan, Nicholas J. A. Harvey, Michael B. Jones, Marvin M. Theimer, and Alec Wolman. Scalable, fault-tolerant, event notification method. US Patent Application 20050086469. Filed October 16, 2003.

### 4. WORK SUBMITTED