

Sushant Sachdeva

Assistant Professor, University of Toronto

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RESEARCH INTERESTS	Algorithms, and its connections to learning, optimization, and statistics My research is focused on the design of fast algorithms for problems ranging from theoretical computer science to machine learning and statistics. My work brings together tools from convex optimization, numerical linear algebra, and approximation theory.	
APPOINTMENTS	University of Toronto	Toronto, ON, Canada
	Assistant Professor, Department of Computer Science	Aug 2017 – Present
	Google	Mountain View, CA, USA
	Research Scientist	Aug 2016 – Aug 2017
	Yale University	New Haven, CT, USA
	Postdoctoral Associate, Department of Computer Science Supervisor: Prof. Daniel Spielman	Jan 2014 – Jul 2016
EDUCATION	Lecturer, Department of Computer Science	Jan 2015 – May 2015
	UC Berkeley , Simons Institute for the Theory of Computing	Berkeley, CA, USA
	Simons Research Fellow	Aug 2013 – Dec 2013
	Program: Real Analysis in Computer Science	
	Princeton University	Princeton, NJ, USA
	Ph.D., Department of Computer Science	Sep 2008 – Sep 2013
HONORS AND AWARDS	Thesis: New Results in the Theory of Approximation — Fast Graph Algorithms and Inapproximability	
	Adviser: Prof. Sanjeev Arora	
	Area of study: Theoretical Computer Science	
	M.A., Department of Computer Science	Sep 2008 – Jun 2010
	GPA: 4.0/4.0	
	Indian Institute of Technology Bombay	Mumbai, India
	B.Tech., Department of Computer Science and Engineering	Jul 2004 – Aug 2008
	Adviser: Sundar Vishwanathan	
	CPI: 9.97/10.00	
	NSERC Discovery Grant 2018-2023 (CAD 172,500)	
HONORS AND AWARDS	Connaught New Researcher Award 2018 (CAD 10,000)	
	Google Faculty Research Award , 2017 (USD 43,335)	
	Simons-Berkeley Research Fellowship , Fall 2013 (USD 26,466)	
	Postdoctoral Research Fellowship by Institute for Computational and Experimental Research in Mathematics (2013-2014, USD 50,000 – declined)	
	President of India Gold Medal for topping the class of 2008 (of 500+ students)	
	Jayanti Deshmukh Memorial Gold Medal for being the most outstanding B.Tech. student in the computer science class of 2008 (out of 35 students)	
	Honorable Mention at ACM ICPC World Finals, Tokyo 2007 representing IIT Bombay	
	1st all over India in IIT Entrance Examination 2004 (among 170,000+ students)	
	Bronze Medalist at 36 th International Chemistry Olympiad (IChO) 2004, Kiel, Germany	
	Perfect SPI of 10.0 in 7 semesters out of 8 at IIT Bombay	
HONORS AND AWARDS	AP grade for outstanding performance in ten courses at IIT Bombay	

Aditya Birla Scholarship 2004–08, covering my undergraduate studies. It is awarded to only 10 engineering students each year.

Dhirubai Ambani Scholarship 2004–08 for being among the top 10 students of Maharashtra state in AISSCE 2004.

Kishore Vaigyanik Protsahan Yojana (KVPY) fellowship 2002–04. Awarded to around 50 students each year; aimed at promoting research careers in the sciences.

- MONOGRAPHS *Faster Algorithms via Approximation Theory*
S. Sachdeva, N. K. Vishnoi
In Foundations and Trends in Theoretical Computer Science 9.2 (FTTCS) 2014, pp. 125–210
- REFEREED JOURNAL PUBLICATIONS *The mixing time of the Dikin walk in a polytope – A simple proof*
S. Sachdeva, N. Vishnoi
In Operations Research Letters, 44.5 (September 2016), pp. 630–634
- An Arithmetic Analogue of Fox’s Triangle Removal Argument*
P. Hatami, S. Sachdeva, M. Tulsiani
In Online Journal of Analytic Combinatorics 11 (OJAC) 2016
- Provable ICA with Unknown Gaussian Noise, and Implications for Gaussian Mixtures and Autoencoders*
S. Arora, R. Ge, A. Moitra, S. Sachdeva
In Algorithmica 72.1 (May 2015), pp. 215–236
- Inapproximability of Minimum Vertex Cover on k -Uniform k -Partite Hypergraphs*
V. Guruswami, S. Sachdeva, R. Saket
In SIAM Journal on Discrete Mathematics 29.1 (SIDMA) 2015, pp. 36–58
- Greedy Geometric Algorithms for Collection of Balls, with Applications to Geometric Approximation and Molecular Coarse-Graining*
F. Cazals, T. Dreyfus, S. Sachdeva, N. Shah
In Computer Graphics Forum 33–6, 2014
- On the Characterization and Selection of Diverse Conformational Ensembles with Applications to Flexible Docking*
S. Lorient, S. Sachdeva, K. Bastard, C. Prevost, F. Cazals
In Computational Biology and Bioinformatics, IEEE/ACM Transactions on 8.2 (TCBB) 2011, pp. 487–498
- REFEREED CONFERENCE / WORKSHOP PUBLICATIONS *Flows in Almost Linear Time via Adaptive Preconditioning*
R. Kyng, R. Peng, S. Sachdeva, D. Wang
To appear at the 51st ACM Symposium on Theory of Computing (STOC) 2019
- Improved Semi-Supervised Learning with Multiple Graphs*
K. Viswanathan*, S. Sachdeva*, A. Tomkins, S. Ravi (*=equal contribution)
In 22nd International Conference on Artificial Intelligence and Statistics (AISTATS) 2019
- Iterative Refinement for ℓ_p -norm Regression*
D. Adil, R. Kyng, R. Peng, S. Sachdeva
In 30th ACM-SIAM Symposium on Discrete Algorithms (SODA) 2019
- Short Cycles via Low-Diameter Decompositions*
Y. P. Liu, S. Sachdeva, Z. Yu
In 30th ACM-SIAM Symposium on Discrete Algorithms (SODA) 2019
- Graph Sparsification, Spectral Sketches, and Faster Resistance Computation, via Short Cycle Decompositions*
T. Chu, Y. Gao, R. Peng, S. Sachdeva, S. Sawlani, J. Wang
To appear at 59th IEEE Symposium on Foundations of Computer Science (FOCS) 2018

Invited to SIAM Journal on Computing **Special Issue**

Invited to **Highlights of Algorithms 2019**

Convergence Results for Neural Networks via Electrodynamics

R. Panigrahy, A. Rahimi, S. Sachdeva, Q. Zhang

In 9th Innovations in Theoretical Computer Science (ITCS) 2018

Near-optimal approximation algorithm for simultaneous Max-Cut

A. Bhangale, S. Khot, S. Kopparty, S. Sachdeva, D. Thiruvengatathari

In 29th ACM-SIAM Symposium on Discrete Algorithms (SODA) 2018

Sampling Random Spanning Trees Faster than Matrix Multiplication

D. Durfee, R. Kyng, J. Peebles, A. B. Rao, S. Sachdeva

In 49th ACM Symposium on Theory of Computing (STOC) 2017

A framework for analyzing resparsification algorithms

R. Kyng, J. Pachocki, R. Peng, S. Sachdeva

In 28th ACM-SIAM Symposium on Discrete Algorithms (SODA) 2017

Approximate Gaussian Elimination for Laplacians: Fast, Sparse, and Simple

R. Kyng, S. Sachdeva

In 57th IEEE Symposium on Foundations of Computer Science (FOCS) 2016

Invited to **Highlights of Algorithms 2017**

Sparsified Cholesky and Multigrid Solvers for Connection Laplacians

R. Kyng, Y. T. Lee, R. Peng, S. Sachdeva, and D. A. Spielman

In 48th ACM Symposium on Theory of Computing (STOC) 2016

Fast, Provable Algorithms for Isotonic Regression in all ℓ_p -norms

R. Kyng, A. B. Rao, S. Sachdeva

In 29th Advances in Neural Information Processing Systems (NIPS) 2015

Algorithms for Lipschitz Learning on Graphs

R. Kyng, A. B. Rao, S. Sachdeva, D. A. Spielman

In 28th Conference on Learning Theory (COLT) 2015

Simultaneous Approximation of Constraint Satisfaction Problems

A. Bhangale, S. Kopparty, S. Sachdeva

In 42nd International Colloquium on Automata, Languages, and Programming (ICALP) 2015

Optimal Inapproximability for Scheduling Problems via Structural Hardness for Hypergraph Vertex Cover

S. Sachdeva, R. Saket

In 28th IEEE Conference on Computational Complexity (CCC) 2013

Approximating the Exponential, the Lanczos Method and an $\tilde{O}(m)$ -Time Spectral Algorithm for Balanced Separator

L. Orecchia, S. Sachdeva, N. K. Vishnoi

In 44th ACM Symposium on Theory of Computing (STOC) 2012

Provable ICA with Unknown Gaussian Noise, and Implications for Gaussian Mixtures and Autoencoders

S. Arora, R. Ge, A. Moitra, S. Sachdeva

In 26th Advances in Neural Information Processing Systems (NIPS) 2012

Invited to **Algorithmica Special Issue for Machine Learning**

Finding Overlapping Communities in Social Networks: Towards a Rigorous Approach

S. Arora, R. Ge, S. Sachdeva, G. Schoenebeck

In 13th ACM Conference on Electronic Commerce (EC) 2012

Testing Permanent Oracles — Revisited

S. Arora, A. Bhattacharyya, R. Manokaran, S. Sachdeva

In 16th International Workshop on Randomization and Computation (RANDOM) 2012

Nearly Optimal NP-Hardness of Vertex Cover on k -Uniform k -Partite Hypergraphs

S. Sachdeva, R. Saket

In 14th International Workshop on Approximation Algorithms for Combinatorial Optimization Problems (APPROX) 2011

THESES

New Results in the Theory of Approximation: Fast Graph Algorithms and Inapproximability

Ph.D. Thesis, Princeton University, 2013. Advised by Sanjeev Arora

On the Hardness of Approximating Vertex Cover

B.Tech. Thesis, IIT Bombay, 2008. Advised by Sundar Vishwanathan

SELECT

Cuts in Cartesian Products of Graphs

MANUSCRIPTS

S. Sachdeva, M. Tulsiani

SUPERVISION

Graduate students:

Deeksha Adil (M.Sc. student, UToronto, 2017–)

Undergraduate students:

Zejun Yu (UToronto, Summer 2018)

Mentees:

Yang P. Liu (Summer 2018). Graduate student, Stanford.

Xiao Shi (Fall 2015). Software Engineer, Facebook.

TALKS

Improved ℓ_p -norm Optimization via Iterative Refinement

Theory Seminar, Northwestern, Evanston, Feb 2019

Theory Seminar, UChicago / TTIC, Chicago, Feb 2019

STOCA Workshop, Google Mountain View, Feb 2019

Approximate Gaussian Elimination and Applications

Laplacian 2.0 Workshop, FOCS 2018, Paris, Oct 2018

Fast Approximate Gaussian Elimination for Laplacians

High Performance Graph Algorithms, Dagstuhl Seminar, Germany, Jun 2018

Canada Applied and Industrial Mathematics Society (CAIMS), Toronto, Jun 2018

Department Seminar, University of Waterloo, Nov 2017

Highlights of Algorithms, Berlin, Jun 2017

Simons Collaboration on Algorithms & Geometry, New York, Mar 2017

TOCA-SV, Stanford, Nov 2016

TCS Plus Seminar, Sep 2016

Theory of Computation Seminar, Harvard University, Sep 2016

Theory Lunch, Boston University, Sep 2016

Fast Algorithms for Optimization and Learning on Graphs

Google, New York, May 2016

Computer Science Colloquium, Purdue University, Apr 2016

Department of Computer Science Lecture, University of Toronto, Canada, Mar 2016

Computer Science Seminar, University of Colorado Boulder, Mar 2016

Regression on Graphs – Lipschitz and Isotonic

Simons Seminar, University of Texas Austin, May 2016

University of Chicago, Scientific and statistical computing seminar, Nov 2015

Lipschitz Learning on Graphs

Theory seminar, CS Department, Carnegie Mellon University, Nov 2016

IIT Bombay, CS department seminar, Jul 2015

EPFL (École Polytechnique Fédérale de Lausanne) INF department seminar, Jul 2015

Conference on Learning Theory (COLT), Paris, Jul 2015

UC San Diego, CS department theory seminar, May 2015

Yale University, Statistics department seminar, Apr 2015

Triangle Removal in Groups

Simons Institute, UC Berkeley, Real analysis seminar, Nov 2013

Institute for Advanced Study (IAS) Computer science/discrete mathematics seminar, Apr 2013

Generalizations of KKL Theorem and Friedgut's Junta Theorem

Simons Institute, UC Berkeley, Real analysis workshop, Aug 2013

Hardness for Scheduling Problems

Conference on Computational Complexity (CCC), Palo Alto, Jun 2013

Near-linear Time Algorithms for Balanced Separator

Rutgers University, DIMACS/CS theoretical computer science seminar, Mar 2013

University of Washington, ETP theory connections, Aug 2012

Symposium on Theory of Computing (STOC), New York, May 2012

Institute for Advanced Study (IAS) Computer science/discrete mathematics seminar, Apr 2012

Testing Permanent Oracles

International Workshop on Randomization and Computation (RANDOM), Boston, Aug 2012

PROFESSIONAL
SERVICE

Program Committee:

Symposium on Theory of Computing (STOC) 2019, Phoenix, AZ, USA

Organizer:

Workshop 'Laplacians 2.0', FOCS 2018, Paris, France

Reviewer: COLT 2019, ICML 2019, ICALP 2019, STOC 2019, SODA 2019, FOCS 2018, NIPS 2018, SICOMP, STOC 2018, ICLR 2018, ICALP 2018, SODA 2018, ICML 2018, FOCS 2017, WADS 2017, SPAA 2017, APPROX 2017, NIPS 2017, STOC 2017, SODA 2017, FOCS 2016, NIPS 2016, STOC 2016, SODA 2016, STOC 2015, SODA 2015, SIDMA, QIC, Random 2014, FOCS 2014, STOC 2014, FSTTCS 2013, SODA 2014, Approx 2013, TOC, Algorithmica, ITCS 2013, SODA 2013, ICALP 2012, LATIN 2012, SODA 2012, FSTTCS 2011

TEACHING
EXPERIENCE

Assistant Professor, University of Toronto

Instructor for CSC 263H5 : Data Structures and Analysis

Winter 2018

Teaching evaluation score : 4.4/5.0

Instructor for CSC 2421H : Fast Algorithms via Continuous Methods

Fall 2017

Teaching evaluation score : 4.5/5.0

Lecturer, Yale University

Lecturer for CPSC 665 : An Algorithmist's toolkit

Spring 2015

Designed and taught a full course on advanced algorithms (2 lectures a week)

55% of students rated the course excellent (highest rating)

Teaching Assistant, Princeton University

Assistant in Instruction for COS 433: Cryptography

Spring 2010

Assistant in Instruction for COS 340: Reasoning About Computation

Fall 2009

PROFESSIONAL
EXPERIENCE

Toyota Technological Institute

Chicago, IL

Research Intern, Summer 2012

Supervisor: Yury Makarychev

Lower bounds for Vertex Sparsifiers.

Microsoft Research India

Bangalore, India

Research Intern, Summer 2011

Supervisor: Nisheeth K. Vishnoi

Fast algorithms for Balanced Separator.

INRIA

Sophia-Antipolis, France

Research Intern, Summer 2007

Supervisor: [Frederic Cazals](#) (Research Director, Geometrica group).

Selecting a representative set of protein conformers.

ETH

Zurich, Switzerland

Research Intern, Summer 2006

Supervisor: [Riko Jacob](#) (Algorithms, Data Structures, and Applications group).

Cache efficiency of shortest path algorithms with preprocessing.

REFERENCES

Prof. Daniel Spielman (spielman@cs.yale.edu)

Henry Ford II Professor of Computer Science, Mathematics, and Applied Mathematics
Yale University

Prof. Sanjeev Arora (arora@cs.princeton.edu)

Charles C. Fitzmorris Professor of Computer Science
Princeton University

(Please contact admin. assistant Mitra Kelly at mkelly@cs.princeton.edu)

Prof. Nisheeth K. Vishnoi (nisheeth.vishnoi@epfl.ch)

Associate Professor of Computer Science
EPFL (École Polytechnique Fédérale de Lausanne)

Prof. Jonathan Kelner (kelner@mit.edu)

Mark Hyman, Jr. Career Development Associate Professor of Applied Mathematics
MIT (Massachusetts Institute of Technology)