Amitabh Basu

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Education

Carnegie Mellon University, Pittsburgh, PA **August 2006 to May 2010**

Ph.D. in Algorithms, Combinatorics and Optimization (ACO).

- Dissertation Topic: *Corner Polyhedra and Maximal Lattice-free Convex Sets : A Geometric Approach to Cutting Planes*
- Advisor: Prof. Gérard Cornuéjols

Stony Brook University, Stony Brook, New York **August 2004 to May 2006**

M.S., Computer Science.

- Thesis Title : *Distributed Localization with Noisy Distance and Angle Information*
- Advisor : Prof. Joe Mitchell

Indian Institute of Technology, Delhi, India **August 2000 to May 2004**

B.Tech., Computer Science and Engineering.

Work Experience

Dept. of Applied Mathematics and Statistics, The Johns Hopkins University, Baltimore **July 2013 - present**
Assistant Professor (tenure-track).

Dept. of Mathematics, University of California, Davis **July 2010 - June 2013**
Krener Assistant Professor.

AT&T Shannon Labs-Research, Florham Park, NJ **May to July 2005**
Summer research intern.

INRIA, Sophia-Antipolis, France **May to July, 2003**
Summer research intern.

Honors and Awards

- *NSF CAREER award*, awarded by the National Science Foundation, 2015.
- *A.W. Tucker Prize 2012* finalist, awarded by the Mathematical Optimization Society every 3 years to three finalists for the best doctoral dissertation worldwide in the field of mathematical optimization.
- *G. Thomas Sallee Mathematics Teaching Award*, awarded by UC Davis Math Dept., 2013.
- *ASUCD Excellence in Education Awards* nominee, awarded by Associated Students of University of California, Davis (ASUCD), 2012.
- *Gerald L. Thompson Award*, awarded by the Tepper School of Business, CMU for the best doctoral dissertation, 2010.
- *Egon Balas Award*, awarded by the Tepper School of Business, CMU for the best student paper in the area of operations research, 2008.
- *William Larimer Mellon Fellowship*, Tepper School of Business, 2006-2009.
- Gold medal at Indian National Physics Olympiad, 2000.
- *National Talent Search Scholar*, awarded by the National Council of Education, Research and Training (NCERT), India, 1998.

Grants

- *National Science Foundation Faculty Early Career Development (NSF CAREER) award*, $500,000, 2015-2020.
- *AMS-Simons Travel Grant*, awarded by the *American Mathematical Society (AMS)* with support provided by the *Simons Foundation*, $4000, 2011-2013.

Professional Service

- Associate Editor, *Mathematics of Operations Research*, January 2013 - present.
- Vice Chair (Integer and Discrete Optimization), *INFORMS Optimization Society*, 2015-17.
- Peer Review Panel member, *National Science Foundation (NSF)*, 2014.
- Chair, Program committee for the *Mixed Integer Programming (MIP) 2014* conference.
- Program committee, *Mixed Integer Programming (MIP) 2013* conference.
- Program committee, *Bay Area Discrete Math (BADMath)* conference, 2012-2013.
- Chair, Local organization committee, *Mixed Integer Programming (MIP) 2012* conference.
- Review Work and Technical Referee for the following journals : *Mathematics of Operations Research, Mathematical Programming, SIAM Journal on Optimization, SIAM Journal on Discrete Mathematics, Naval Research Logistics, European Journal of Operational Research, Operations Research Letters, International Journal of Computational Geometry and Applications.*

Research Papers

Papers under review

R1 Computing approximate PSD Factorizations, *submitted*
Joint Work with Mike Dinitz and Xin Li

R2 Strong duality and sensitivity analysis in semi-infinite linear programming, *submitted*
Joint Work with Kipp Martin and Chris Ryan

R3 Equivariant Perturbation in Gomory and Johnson's Infinite Group Problem III. Foundations for the k-Dimensional Case and Applications to $k = 2$, *submitted*
Joint Work with Robert Hildebrand and Matthias Köppe

Papers published/in press in refereed Journals and Conference Proceedings

P1 Centerpoints: A link between optimization and convex geometry, *to appear in Proceedings of IPCO 2016*
Joint Work with Timm Oertel

P2 Minimal Cut-Generating Functions are nearly Extreme, *to appear in Proceedings of IPCO 2016*
Joint Work with with Robert Hildebrand and Marco Molinaro

P3 Extreme functions with an arbitrary number of slopes, *to appear in Proceedings of IPCO 2016*
Joint Work with Michele Conforti, Marco Di Summa and Joseph Paat

P4 Light on the infinite group problem, *invited survey to appear in 4OR: A quarterly journal of operations research*
Joint Work with Robert Hildebrand and Matthias Köppe

P5 Operations that preserve the Covering Property of the Lifting Region, *SIAM Journal on Optimization, vol. 25(4), 2015, pp. 2313-2333*, `http://dx.doi.org/10.1137/140990413`
Joint Work with Joseph Paat

P6 Lifting Properties of Maximal Lattice-free Polyhedra, *Mathematical Programming, vol. 154(1), 2015, pp. 81-111*, `http://dx.doi.org/10.1007/s10107-015-0865-6`
Joint Work with Gennadiy Averkov

P7 A geometric approach to cutting planes, *Mathematical Programming, vol. 151(1), 2015, pp. 153–189*, http://dx.doi.org/10.1007/s10107-015-0865-6
Joint Work with Michele Conforti and Marco Di Summa

P8 Projection: A Unified Approach to Semi-Infinite Linear Programs and Duality in Convex Programming, *Mathematics of Operations Research, vol. 40(1), 2015, pp. 146–170*, http://dx.doi.org/10.1287/moor.2014.0665,
Joint Work with Kipp Martin and Chris Ryan

P9 Equivariant Perturbations for Gomory and Johnson's Infinite Group Problem I. The One-Dimensional Case, *Mathematics of Operations Research, vol. 40(1), 2015, pp. 105–129*, http://dx.doi.org/10.1287/moor.2014.0660
Joint Work with Robert Hildebrand and Matthias Köppe

P10 Characterization of the Split Closure via Geometric Lifting, *European Journal of Operational Research, vol. 243(3), 2015, pp. 745-751*,
http://dx.doi.org/10.1016/j.ejor.2014.12.018
Joint Work with Marco Molinaro

P11 On the Unique-lifting Property, *Proceedings of IPCO 2014, LNCS 8494, 2014, 76–87.*
Joint Work with Gennadiy Averkov

P12 On the sufficiency of finite support duals in semi-infinite linear programming,
Operations Research Letters, vol. 42 (1), 2014, 16–20.
Joint Work with Kipp Martin and Chris Ryan

P13 The Triangle Closure is a Polyhedron,
Mathematical Programming, vol. 145 (1-2), 2014, 19–58.
Joint Work with Robert Hildebrand and Matthias Köppe

P14 On Chubanov's method for Linear Programming,
INFORMS Journal on Computing, vol. 26(2), 2014, pp. 336–350.
Joint Work with Jesús De Loera and Mark Junod

P15 A $(k+1)$-Slope Theorem for the k-Dimensional Infinite Group Relaxation,
SIAM Journal on Optimization, vol. 23 (2), 2013, 1021–1040.
Joint Work with Robert Hildebrand, Matthias Köppe and Marco Molinaro

P16 Equivariant Perturbations for Gomory and Johnson's Infinite Group Problem. II. The Unimodular Two Dimensional Case,
Proceedings of IPCO 2013, LNCS 7801, 2013, 62–73.
Joint Work with Robert Hildebrand and Matthias Köppe

P17 Unique Lifting of Integer Variables in Minimal Inequalities,
Mathematical Programming, vol. 141, 2013, 561–576.
Joint Work with Manoel Campelo, Michele Conforti, Gérard Cornuéjols and G. Zambelli

P18 A Counterexample to a Conjecture of Gomory and Johnson,
Mathematical Programming, vol. 133 (1-2), 2012, 25–38.
Joint work with Michele Conforti, Gérard Cornuéjols and Giacomo Zambelli

P19 Unique Minimal Liftings for Simplicial Polytopes,
Mathematics of Operations Research, vol. 37 (2), 2012, 346–355.
Joint work with Gérard Cornuéjols and Matthias Köppe

P20 Intersection Cuts with Infinite Split Rank,
Mathematics of Operations Research, vol. 37 (1), 2012, 21–40.
Joint work with Gérard Cornuéjols and François Margot

P21 A Probabilistic Analysis of the Strength of Split and Triangle Closures,
Proceedings of IPCO 2011, New York, LNCS 6655, 2011, 27–38.
Joint work with Gérard Cornuéjols and Marco Molinaro

P22 Convex Sets and Minimal Sublinear Functions,
Journal of Convex Analysis, vol. 18(2), 2011, 427–432.
Joint work with Gérard Cornuéjols and Giacomo Zambelli

P23 Experiments with two-row cuts from degenerate tableaux,
INFORMS Journal on Computing, vol. 23(4), 2011, 578–590.
Joint work with Pierre Bonami, Gérard Cornuéjols and Francois Margot

P24 On the Relative Strength of Split, Triangle and Quadrilateral Cuts,
Mathematical Programming, vol. 126 (2), 2011, 281–314. (Preliminary version in Proc. Symposium on Discrete algorithms (SODA), New York, January 2009).
Joint work with Pierre Bonami, Gérard Cornuéjols and François Margot

P25 Maximal Lattice-free Convex Sets in Linear Subspaces,
Mathematics of Operations Research, vol. 35(3), 2010, 704–720.
Joint work with Michele Conforti, Gérard Cornuéjols and Giacomo Zambelli

P26 Minimal Inequalities for an Infinite Relaxation of Integer Programs,
SIAM Journal on Discrete Mathematics, vol. 24(1), 2010, 158–168.
Joint work with Michele Conforti, Gérard Cornuéjols and Giacomo Zambelli

P27 On Lifting Integer Variables in Minimal Inequalities,
Proceedings of IPCO 2010, Lausanne, LNCS 6080 (2010), 85–95.
Joint work with Manoel Campelo, Michele Conforti, Gérard Cornuéjols and Giacomo Zambelli

P28 Geometric Algorithms for Optimal Airspace Design and Air Traffic Controller Workload Balancing,
ACM Journal on Experimental Algorithmics 14 (2), 2009, 3–28. (Preliminary version in Proc. ALENEX 2008).
Joint work with Joe Mitchell and Girishkumar Sabhnani

P29 Distributed Localization using Noisy Distance and Angle Information,
Preliminary version in Proc. of the Seventh ACM International Symposium on Mobile Ad Hoc Networking and Computing (MobiHoc'06), 262–273, Florence, Italy, May 2006.
Joint work with Jie Gao, Joe Mitchell and Girishkumar Sabhnani

P30 Security types preserving compilation,
Computer Languages, Systems and Structures 33, 2, July 2007, 35–59.
Joint work with Gilles Barthe and Tamara Rezk

Working Papers

W1 How to choose what you lift
In Preparation with Santanu Dey and Joseph Paat

W2 Galaxy redshifts from discrete optimization of correlation functions
In Preparation with Tamas Budavari and Benjamin Lee

W3 Approximation guarantees of closures
In Preparation with Gennadiy Averkov and Joseph Paat

W4 Eliminating pathologies in the infinite group relaxation
In Preparation with Michele Conforti, Marco Di Summa and Joseph Paat

Invited Talks

- Introduction to Cut-Generating Functions, *Workshop on "Modern Techniques in Discrete Optimization: Mathematics, Algorithms and Applications", jointly orgranized by Casa Matématica Oaxaca and Banff International Research Station, Oaxaca, Mexico, November 2015.*
- Cut-Generating Functions: A tour d'horizon, *Invited tutorial in Polyhedral Combinatorics (PoCo 2015), Carnegie Mellon University, July 8 -12, 2015.* PoCo 2015 is a summer school featuring lectures by experts in combinatorial and discrete optimization.

- Approximate PSD Factorizations, *Mixed Integer Programming (MIP) conference, Chicago, June 2015.*
- Techniques for the Infinite Group Problem,
  - 19^{th} *Aussois Combinatorial Optimization Workshop, Aussois, France, January 2015.*
  - *AMS spring eastern sectional meeting, Washington, D.C., March 2015.*
  - *International Symposium on Mathematical Programming (ISMP), Pittsburgh, July 2015.*
- On the Covering Property of the Lifting Region,
  - *Systems, Information, Learning and Optimization (SILO) seminar, U. Wisc.-Madison, April 2015.*
  - *Combinatorial Optimization workshop, Oberwolfach, Germany, November 2014.*
  - *Operations Research seminar, Carnegie Mellon University, October 2014.*
  - *Operations Research and Discrete Math seminar, Clemson University, October 2014.*
- On the Sufficiency of Finite Support Duals in Semi-infinite Linear Programming, *SIAM conference on optimization, San Diego, USA, May 2014.*
- Projection: A Unified Approach to Semi-Infinite Linear Programs with applications to Convex Optimization,
  - *Optimization seminar, ETH Zurich, Zurich, Switzerland, May 2014.*
  - *Foundations of Computational Mathematics conference, Uruguay, December 2014.*
  - *Statistical Sciences and Operations Research (SSOR) and Discrete Mathematics seminar, Virginia Commonwealth University, September 2015.*
  - *Center for Scientific Computing and Mathematical Modeling (CSCAMM) seminar, U. Maryland-College Park, October 2015.*
- Recent Progress in Gomory and Johnson's Infinite Group Problem,
  - *AMS spring eastern sectional meeting, Baltimore, MD, March 2014.*
  - *Colloquium seminar at Dept. of Mathematics, U.S. Naval Academy, Annapolis, MD, March 2014.*
  - *Integer programming seminar at IBM T.J.Watson Research Center, Yorktown Heights, NY, January 2014.*
  - *INFORMS annual meeting, Minneapolis, MN, USA, October 2013.*
- On the Unique-lifting property, 18^{th} *Aussois Combinatorial Optimization Workshop, Aussois, France, January 2014.*
- Fresh Developments in Discrete Optimization, *Numerical Optimization seminar, Mathematical Institute, Oxford University, UK, January 2013.*
- Mixed-Integer Linear Programming: A Solution Methodology, *Colloquium seminar at:*
  - *Management Science and Engineering dept., Stanford University, Palo Alto, CA, USA, February 2013.*
  - *Operations Reearch and Industrial Engineering dept., Cornell, University, Ithaca, NY, USA, February 2013.*
  - *Booth School of Business, University of Chicago, Chicago, IL, USA, January 2013.*
  - *Operations and Industrial Engineering dept., University of Michigan, Ann Arbor, MI, USA, January 2013.*
  - *Tippie School of Business, University of Iowa, Iowa City, IA, USA, February 2013.*

- A $(k+1)$-slope theorem for the Infinite Group Problem, *International Symposium on Mathematical Programming (ISMP), Berlin, Germany, August 2012*
  Bay Area Discrete Mathematics (BADMath) conference, University of California, Davis, October 2011.
- Unique Minimal Liftings for Minimal Inequalities, *Mixed Integer Programming (MIP) conference, University of Waterloo, Ontario, Canada, June 2011.*
- Recent Trends in Cutting Planes for Mixed-Integer Linear Programs, *Discrete Optimization Workshop, Program on Optimization and its Applications at Institute for Pure and Applied Mathematics (IPAM), UCLA, Los Angeles, California, October 2010.*
- Intersection Cuts with Infinite Split Rank, *INFORMS, Austin, Texas, 2010.*
- Convex Sets and Minimal Sublinear Functions, *INFORMS, Austin, Texas, 2010.*
- On Lifting Integer Variables in Minimal Inequalities, *INFORMS, Austin, Texas, 2010*, *Workshop on Multi-row Cuts, Bertinoro, Italy, November 2009.*
- A Counterexample to a Conjecture of Gomory and Johnson, *International Symposium on Mathematical Programming (ISMP), Chicago, USA, August 2009.*
- On the Relative Strength of Two Row Cuts for MILPs, *INFORMS, San Diego, USA, 2009.*
- Corner Polyhedra and Maximal Lattice-free Sets : A Geometric Approach to Cutting Plane Theory, *INFORMS, San Diego, USA, 2009.*

Teaching Experience

Committee and Advising Activities

- *PhD Thesis advisor:* Joseph Paat (Ph.D. candidate in Applied Math and Statistics, JHU), Anirbit Mukherjee (Ph.D. candidate in Applied Math and Statistics, JHU).
- *PhD Thesis committee member (* indicates chair of committee):* Qi Wang (Ph.D. in Applied Math and Statistics, JHU, 2013), Stephen Chestnut (Ph.D. in Applied Math and Statistics, JHU, 2015), Heng Weng* (Ph.D. in Applied Mathematics and Statistics, Johns Hopkins U., Fall 2015).
- *Master's thesis advisor:* Paul Markakis (M.S. in Applied Math and Statistics, JHU, 2015).
- *Master's thesis committee member:* Brandon Crain (M.S. in Mathematics, UC Davis, 2012).
- *Graduate Board Oral exam committee member:* Heng Weng (Ph.D. candidate in Applied Math and Statistics, JHU, 2013), Xinlei Zhang (Ph.D. candidate in Electrical and Computer Engineering, JHU, 2014), Hao Jiang (Ph.D. candidate in Applied Math and Statistics, JHU, 2014), Golnoosh Kamali (Ph.D. candidate in Electrical and Computer Engineering, JHU, 2015), Joseph Paat (Ph.D. candidate in Applied Math and Statistics, JHU, 2015), Lin (Forrest) Yang (Ph.D. candidate in Computer Science, JHU, 2015).
- *Ph.D. candidacy exam committee member:* Gaoran Yu, Shangsi Wang, Joe Paat, Elizabeth Reiland (Ph.D. candidates in Applied Math and Statistics, JHU).
- Robert Hildebrand (Ph.D. in Mathematics), Faculty presenter at PhD hooding ceremony, UC Davis, 2013.

Instructor

Graduate courses

- **AMS 550.672: Graph Theory**, Spring 2014, 2015 at Johns Hopkins U.
  Introduction to graph theory: basic definitions, connectivity, trees, matchings, colorings, planarity, random graphs.
  Overall Teaching Evaluation : 4.67/5.0 (Spring 2014 - enrollment : 15), 4.82/5.0 (Spring 2015 - enrollment : 14)

- **AMS 550.666: Combinatorial Optimization**, Fall 2013, 2014, 2015 at Johns Hopkins U.
  Introduction to basic techniques in combinatorial optimization (flow, matchings, polyhedral combinatorics, matroids).
  Overall Teaching Evaluation : 4.55/5.0 (Fall 2013 - enrollment : 18), 4.8/5.0 (Fall 2014 - enrollment : 13), 4.83/5.0 (Fall 2015 - enrollment: 11).

Undergraduate courses

- **AMS 550.472: Graph Theory**, Spring 2015, Spring 2014 at Johns Hopkins U.
  Introduction to graph theory: basic definitions, connectivity, trees, matchings, colorings, planarity, random graphs.
  Overall Teaching Evaluation : 5.0/5.0 (Spring 2015 - enrollment : 8), 4.38/5.0 (Spring 2014 - enrollment : 11)
- **MAT 25: Advanced Calculus**, Spring 2013 at UC Davis.
  Introduction to the rigorous treatment of abstract mathematical (real) analysis.
  Overall Teaching Evaluation : 4.7/5.0 (enrollment : 59).
- **MAT 165: Mathematics and Computers**, Fall 2012 at UC Davis.
  Introduction to computational mathematics and symbolic computation via the study of computational algebraic geometry.
  Overall Teaching Evaluation : 4.4/5.0 (enrollment : 23).
- **MAT 17B: Calculus for Biology & Medicine**, Fall 2012, Spring 2012, Fall 2011 at UC Davis.
  This is the second course in the calculus series offered to biology majors at UC Davis.
  Overall Teaching Evaluation : 4.9/5.0 (Fall 2012 - enrollment : 149), 4.9/5.0 (Spring 2012 - enrollment : 95), 4.5/5.0 (Fall 2011 - enrollment : 145).
- **MAT 16A: Short Calculus I**, Spring 2012 at UC Davis.
  This is the first course in the entry-level calculus series offered at UC Davis.
  Overall Teaching Evaluation : 4.7/5.0 (enrollment : 225).
- **MAT 16B: Short Calculus II**, Spring 2011 at UC Davis.
  This is the second course in the entry-level calculus series offered at UC Davis.
  Overall Teaching Evaluation : 4.5/5.0 (enrollment : 89).
- **MAT 16C: Short Calculus III**, Spring 2011 at UC Davis.
  This is the third and final course in the entry-level calculus series offered at UC Davis.
  Overall Teaching Evaluation : 4.1/5.0 (enrollment : 83).
- I co-taught **Advanced Integer Programming** (with Gérard Cornuéjols) at Carnegie Mellon University in Spring 2010. This is a core course for PhD students in the Operations Research and ACO programs at CMU. More details/lecture notes at :
  `http://www.math.ucdavis.edu/~abasu/teaching.html`
- I have led a *Research Focus Group (RFG)* under the framework of the NSF-funded VIGRE program in the Department of Mathematics at UC Davis for the 2011-2012 academic year. This involved running regular research seminars, mini courses and workshops over the course of the 2010-2011 academic session, focused towards applications of convex geometry. Duties involved giving expository lectures to a group of 10-15 mathematics PhD students and faculty, organizing presentations by participants and outside speakers, holding discussions and encouraging motivated PhD students to attack open problems. More details/lecture notes can be found at : `http://www.math.ucdavis.edu/~abasu`