

Bala Krishnamoorthy

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EDUCATION

- University of North Carolina at Chapel Hill, North Carolina.
Ph.D. in Operations Research, (August 2004).
 - Dissertation Topic: "Pre-conditioning integer programs using column basis reduction."
Advisor: Gábor Pataki.
 - Dissertation Topic: "Geometry and Topology of Protein Structure"
Advisors: Scott Provan, Alex Tropsha.
- Indian Institute of Technology, Chennai, India.
B.Tech., Mechanical Engineering, May, 1999.

PROFESSIONAL EXPERIENCE

- Assistant Professor, Department of Mathematics, Washington State University, August, 2004 – present. Responsibilities include research, teaching, and service.
- Research assistant, University of North Carolina at Chapel Hill, August, 2001 – August, 2004.
 - Supervised by Gábor Pataki, January, 2001 – August, 2004.
Studying basis reduction algorithms and their applications to integer programming.
 - Supervised by Alex Tropsha and Scott Provan, August, 2001 – August, 2004.
Application of concepts and techniques from geometry and topology to protein structure and related problems.
 - Graduate student member, BioGeometry, August, 2003 – August, 2004.
Collaborating with researchers from Biochemistry on the identification of tetrahedral motifs in protein structures that could be used to refine electron density data from crystallography.
(ref: <http://biogeometry.duke.edu>).
- Graduate instructor, University of North Carolina at Chapel Hill, August, 1999 - July, 2001.
 - Taught five freshman and sophomore level classes in business calculus and management science.
- *Summer project*, IBM, Research Triangle Park, NC, May - August, 2000.
 - Worked with the Worldwide Quality Group of IBM on the development of a tool that uses integer programming and simulation to determine the optimal testing policy to ensure the production of highest quality personal computers while satisfying demand.

PUBLICATIONS

1. Development of a four-body statistical pseudo-potential to discriminate native from non-native protein conformations. *Bioinformatics*, 19, 2003, p1540-1548; (with Alex Tropsha).
2. A topological Characterization of Protein Structure. Book chapter in *Data Mining in BioMedicine*, edited by Panos M. Pardalos, Vladimir Boginski, and Alkis Vazacopoulos, Springer, 2007, ISBN: 0-387-69318-1; accepted in November 2005. (with Scott Provan and Alex Tropsha).
3. Bounds on the size of branch-and-bound proofs for integer knapsacks. *Operations Research Letters*, 36, 1, p19-25, 2008. Published on-line in 2007. DOI: <http://dx.doi.org/10.1016/j.orl.2007.04.011>

4. Column basis reduction and decomposable knapsack problems. *Discrete Optimization*, 6, 3, p242-270, 2009. (With Gábor Pataki). Preprint: www.optimization-online.org/DB_HTML/2007/06/1701.html.
5. Four-body scoring function for mutagenesis. *Bioinformatics*, 23, 22, p3009-3015, 2007. (with Christopher Deutsch). URL: <http://bioinformatics.oxfordjournals.org/cgi/content/abstract/23/22/3009>
6. A hierarchy of Delaunay tessellation-based scoring functions for protein fold recognition and mutagenesis. *Algorithms for Molecular Biology*, under review. (with Andrew Fowler, Kelly Stratton, and Christopher Deutsch). Preprint: www.math.wsu.edu/faculty/bkrishna/DT/HierarchyDTPots/.
7. Lattice-based Algorithms for Number Partitioning in the Hard Phase. *Discrete Optimization*, under review. Preprint: www.optimization-online.org/DB_HTML/2008/10/2118.html.

PAPERS IN PREPARATION

1. Thinner is not better: Cascade knapsack problems and column basis reduction (with Gábor Pataki). Draft, and instances: www.math.wsu.edu/faculty/bkrishna/CKP/.
2. Optimized scoring functions for solubility mutagenesis (with Ye Tian). Poster: http://www.math.wsu.edu/faculty/bkrishna/Papers/Final_PosterShowCase_Tian.pdf.
3. Effect of curved muscle paths on neck biomechanics (with Bethany Suderman and Anita Vasavada). Abstract: <http://www.math.wsu.edu/faculty/bkrishna/Papers/NWBSAbstract.2009.pdf>.
4. Lattice-based cryptosystems using recurrence sequences (with William Webb and Nathan Moyer).
5. Optimization models for habitat reserve management (with Natalie Baerlocher and David Allen). Poster: <http://www.math.wsu.edu/faculty/bkrishna/Papers/HabitatMgmtOpt.pdf>.

PRESENTATIONS

1. *Decomposable knapsack problems and column basis reduction* – in the 18th International Symposium on Mathematical Programming (ISMP), Copenhagen, Denmark, August, 2003.
2. *A topology-based characterization of protein structure* – **invited talk** in the Conference on Data Mining in Biomedicine, University of Florida, Gainesville, February, 2004. (Organized by the Center for Applied Optimization, University of Florida, and Dash Optimization).
3. *A knapsack cryptosystem secure against attacks using basis reduction and integer programming* 19th International Symposium on Mathematical Programming (ISMP), Rio de Janeiro, Brazil, August 2006.
4. *UBM: Foundation in Mathematical Biology through Interdisciplinary Research, Training, and Curriculum Development* Invited poster at the Joint Mathematics Meetings, New Orleans, January, 2007.
5. *IP Instances that are Hard for Column Basis Reduction* – **invited talk** at the INFORMS International Meeting, Puerto Rico, July, 2007.
6. *Heuristics for Number Partitioning using Basis Reduction and Integer Programming* – **invited colloquium at IBM T.J. Watson Research Center**, New York, May 5, 2008.
7. *Basis Reduction and Integer Programming Approaches to Number Partitioning* – **invited talk** at the West Coast Optimization Meeting, Seattle, May 18, 2008.
8. *Cascade Knapsack Problems* – **invited talk at the Workshop on Mixed Integer Programming (MIP 2008)**, at Columbia University, New York, August 4-7, 2008. (Invited among 22 speakers for single-track talks).
9. *Lattice-based Approaches to Number Partitioning in the Hard Phase* – **invited talk** at the AMS Western Section Meeting, San Francisco, April 25-26, 2009.
10. *Habitat Reserve Selection for Territorial Disperser Species* – **invited talk** at the INFORMS Annual Meeting, San Diego, October, 2009.

GRANTS

1. UBM: *Foundation in Mathematical Biology through interdisciplinary research, training, and curriculum development*, NSF, \$905,000 (total amount), 2006-2011 – Co-PI.
2. *Haloadaptation and cosolute effects on protein function* – proposal submitted to NIH (August 2009), *under review* – co-PI (with Lisa Gloss, WSU, PI).

COLLABORATIVE RESEARCH PROJECTS

- ❑ Minimal simplicial homology cycles (Tamal Dey, Ohio State CSE, and Anil Hirani, UIUC CS).
- ❑ Knapsack-type public-key cryptosystems (William Webb, Mathematics, WSU)
- ❑ Geometry, solubility, and stability of DHFR proteins (Lisa Gloss, Molecular Biosciences, WSU)
- ❑ Predicting temperature sensitive mutations (Ping Ye, Molecular Biosciences, WSU)
- ❑ Neck muscle geometry and optimization (Anita Vasavada, Bioengineering, WSU)

GRADUATE STUDENTS SUPERVISED

1. Ye Tian (current PhD student, MS in Summer 2008)
2. Nathan Moyer (current PhD student, MS in Spring 2006; joint with Bill Webb)
3. Lisa Tripp (MS in Spring 2007, PhD student in Psychology now, working jointly with me)
4. John Chuba (MS, Summer 2006)
5. Andrew Fowler (MS, Summer 2006)
6. Sunaina Mukherjee (MS, Summer 2007)

OTHER GRADUATE STUDENT COMMITTEE SERVICE

- Yuntao Zhu, PhD Committee (2007)
- Chris Kanyer, MS committee (2006)
- Jeff Noel, MS committee (2007)
- Lisa Ellison, MS committee (2008)
- Sherod Eubanks, PhD committee (2010, expected)
- Limin Yang, PhD committee (2011, expected)

UNDERGRADUATE STUDENTS SUPERVISED

1. Christopher Deutsch, senior, Biochemistry major, research under UBM project (May 2006-June 2008)
2. Kelly Stratton, senior, Mathematics major, research under UBM project (May 2006-March 2007)
3. Natalie Baerlocher, senior, Mathematics major, research under UBM project (May 2007-June 2008)
4. Konstantin Stakhovich, senior, Mathematics major, research under UBM project (May 2007-May 2008; joint with Anita Vasavada, Bioengineering)
5. Keith Clawson, junior, Mathematics major, research on integer programming methods (February 2008-December 2008)
6. Svetlana Lockwood, senior, Mathematics major, research under UBM project (February 2008-present).
7. Derek Nevins, senior, Bioengineering major, research under UBM project (May 2009-present; joint with Anita Vasavada, Bioengineering).

PAST AND CURRENT INSTRUCTION

Term/year	Cr No.	Course title	Cred. hr	Enrol.
Fall 2004	566	Network Optimization	3	7 + 1
Spring 2005	364	Principles of Optimization	3	19
Fall 2005	220	Introduction to Linear Algebra	2	85
Fall 2005	364	Principles of Optimization	3	17
Fall 2005	567	Integer Optimization	3	7 + 1
Spring 2006	574	Optimization Models in Computational Biology	3	13 + 1
Fall 2006	466/566	Network Optimization	3	2, 8†
Spring 2007	464	Linear Optimization	3	10
Fall 2007	220	Introduction to Linear Algebra	2	85
Fall 2007	364	Principles of Optimization	3	25
Spring 2008	574	Optimization Models in Computational Biology	3	10
Fall 2008	466/566	Network Optimization	3	1, 10†
Fall 2008	201 ‡	Finite Mathematics	3	108
Spring 2009	567	Integer Optimization	3	5 + 1
Spring 2009	581 §	Image and Data Analysis	3	10
Fall 2009	220	Introduction to Linear Algebra	2	99
Fall 2009	364	Principles of Optimization	3	17

Table 1: All are MATH courses (Cr No. gives the course numbers). Graduate level courses are numbered 500 and above. Cred. hr gives the credit hours for each course. Enrol. gives the enrollment. The + 1 in enrollment indicates that one student audited the course. † : In Fall 2006, There were 2 students in 466, and 8 in 566 (similar break-up for Math 566 in Fall 2008). ‡ : Replaced by substitute instructor for the last 8 weeks due to a health emergency. § : Taught jointly with Kevin Vixie and Tom Asaki (each instructor responsible for one-third of the course).

COURSE AND TEACHING EVALUATION SUMMARIES

Term/year	Cr No.	# stud	Q1	Q2	Q3	Q4
Fall 2004	566	7	4.71	5.00	4.86	5.00
Spring 2005	364	13	4.69	4.31	3.54	4.15
Fall 2005	220	49	4.63	4.31	4.31	4.45
Fall 2005	364	16	4.63	4.44	4.31	4.44
Fall 2005	567	7	4.86	4.29	5.00	4.71
Spring 2006	574	10	4.60	4.40	4.60	4.50
Fall 2006	466/566	10	4.70	4.10	4.60	4.50
Spring 2007	464	7	4.71	4.71	4.86	5.00
Fall 2007	220	85	4.54	4.27	4.00	4.33
Fall 2007	364	25	4.85	4.85	4.85	4.95
Spring 2008	574	8	4.63	4.43	4.88	5.00
Fall 2008	466/566	9	4.89	4.89	4.78	4.78
Spring 2009	567	5	5.00	5.00	5.00	5.00
Spring 2009	581 §	9	4.89	4.33	4.78	4.67

Table 2: All are MATH courses (Cr No. gives the course numbers). # stud gives the number of students who responded to the survey for each course (see Table 1 for the total enrollments). Q1 – instructor’s preparation, Q2 – instructor’s explanations and demonstrations, Q3 – quality of interaction with students, Q4 – overall impression. 5.00 is the maximum (perfect) score. § : Scores were obtained *separately* for each of the three instructors.

DEPARTMENTAL SERVICE

- Discrete Math Faculty Search Committee, 2007-2008.
- Undergraduate Recruiting Committee, August 2009-present.
- Actively represented the department in WSU Open House and Junior Showcase events.
- PhD qualifying exam committee – January, 2005; January, 2007; August 2009.
- Advising Undergraduate Math Club, August 2005-August 2008, August 2009-present.
- PhD Evaluation Committee, 2005-06.

INSTITUTIONAL SERVICE (AT WSU)

- Member of Bioinformatics Faculty Search Committee, School of EECS, 2006-7.
- Part of Bioinformatics curriculum planning team (faculty from various departments working on building a Bioinformatics graduate program on campus).
 - Judge for College of Sciences Undergraduate Poster Competition (March, 2006).

PROFESSIONAL SERVICE (OUTSIDE WSU)

- Journal reviewer for
 - Mathematical Programming
 - SIAM Journal of Discrete Mathematics
 - SIAM Journal of Optimization
 - INFORMS Journal of Computing
 - Bioinformatics
 - Pacific Symposium on Biocomputing
 - Journal of Computational Chemistry
 - Journal of Theoretical Biology
 - *Clustering Challenges in Biological Networks* - book for DIMACS challenge
- Review Panel Member for the NSF UBM program.
- Organized (along with a team of four others) the Workshop on *OR and Biology*, held as part of the INFORMS Annual Meeting, Pittsburgh, November 2006.
- Chair of invited session on *OR Applications in Computational Biology* at the INFORMS Annual Meeting, San Francisco, CA, November, 2005.
- Chair of invited session on *Optimization in Computational Biology* at the INFORMS International Meeting, Puerto Rico, July, 2007.

HONORS AND AWARDS

- Selected by the Institute for Mathematics and its Applications (IMA) at University of Minnesota to attend the New Directions Short Course on Applied Algebraic Topology, June 15-26, 2009 (limited to 25 faculty, selected based on application).
- Recognized as an *Outstanding Mentor* in 2009 by the Women and Leadership Alliance Forum, WSU.
- Mentor for Svetlana Lockwood, winner of the Barry M. Goldwater scholarship for 2009-2010.
- Mentor for winners in the College of Sciences Undergraduate poster competition at WSU:
 - Chris Deutsch, first prize, 2007.
 - Chris Deutsch, first prize, 2008.
 - Svetlana Lockwood, first prize, 2009.
- Selected by the Department of Operations Research at the University of North Carolina to participate in the Doctoral Colloquium at the INFORMS Annual Meeting, Atlanta, October 2003.
- Inducted into the Frank Porter Graham Graduate and Professional Student Honor Society, University of North Carolina at Chapel Hill, April, 2002.
- Placed in the top 0.2% among more than 100,000 candidates appearing for the Joint Entrance Examination (JEE 95) for admission to the Indian Institutes of Technology (IITs).

PROFESSIONAL AFFILIATIONS

- Member of the Mathematical Programming Society (MPS).
- Member of the Institute for Operations Research and Management Science (INFORMS).
- Member of the International Association for Cryptologic Research (IACR).
- Member of the American Mathematical Society (AMS).

COMPUTER SKILLS

- Packages: MATLAB, Maple, NTL, L^AT_EX
extensive use of AMPL and CPLEX, including the use of CPLEX callable libraries.
- Languages: C/C++, Awk and Unix shell scripts, and some use of Perl scripts.
- Platforms: Unix/Linux, Windows.