

Bistra Dilkina, Ph.D.

Assistant Professor

School of Computational Science and Engineering

College of Computing

co-director Data Science for Social Good - Atlanta Georgia Institute of Technology

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INTERESTS Computational Sustainability; Artificial Intelligence; Optimization; Constraints.

Achieving sustainability requires balancing economic, environmental and social needs, and hence decision and optimization problems are at the heart of many sustainability issues. My research focus is on advancing the state of the art in combinatorial optimization techniques for solving real-world large-scale problems, particularly ones that arise in sustainability areas such as biodiversity conservation planning and urban planning. My work spans discrete optimization, network design, stochastic optimization, satisfiability, and machine learning.

EDUCATION **Cornell University**, Ithaca, NY, USA **Jan 2012**
Doctor of Philosophy (Ph.D), Computer Science (Minor in Operations Research)
• Advisor: [Carla Gomes](#); Committee: [David Shmoys](#) and [Dexter Kozen](#)
• Thesis Title: *Exploiting Structure in Combinatorial Problems with Applications in Computational Sustainability*

Simon Fraser University, Burnaby, BC, Canada **May 2004**
Bachelor of Science (B.Sc.), Computer Science with *Highest Honors*
• Research Advisor: [William S. Havens](#)

AWARDS

Georgia Tech Edenfield Faculty Fellowship Award	2017
LexisNexis Dean's Excellence Award in the College of Computing	2017
KDD Best Student Paper Award Runner-up (Applied Data Science)	2016
Fellow at the Brook Byers Institute for Sustainable Systems	2015
Lockheed Inspirational Young Faculty Award	2015
Raytheon Faculty Fellowship	2015
Georgia Power Professor of Excellence Award	2014
Best paper award, ENRE Sessions in Forestry, INFORMS Annual Meeting	2011
NSERC Postgraduate Scholarship	2008-2010
Graduate Teaching Assistant Award, Computer Science, Cornell University	2008
Nominated for Best paper Award, AAAI: Conference on Artificial Intelligence	2007
Google Anita Borg Scholarship	2007
Dean of Applied Sciences Convocation Medal, Simon Fraser University	2004
CRA Outstanding Undergraduate Researcher Award	2003
B.C. Sugar Achievement Award	2003
International Gordon M. Shrum Scholarship	1999-2004
United World College Scholarship	1997-1999

PEER-REVIEWED PUBLICATIONS **Learning to Run Heuristics in Tree Search.** Khalil, E. B.; *Dilkina, B.*; Nemhauser, G.; Ahmed, S.; and Shao, Y. IJCAI-17: International Joint Conference on Artificial Intelligence, 2017.

Dynamic Optimization of Landscape Connectivity Embedding Spatial-Capture-Recapture Information. Y. Xue, X. Wu, D. Morin, *B. Dilkina*, A. Fuller, J.A. Royle, C.P. Gomes. AAAI-17: AAAI Conference on Artificial Intelligence, 2017.

Achieving full connectivity of sites in the multiperiod reserve network design problem. N. Jafari, B.L. Nuse, C.T. Moore, *B. Dilkina*, J. Hepinstall-Cymerman. Computers & Operations Research (journal), Volume 81, Pages 119-127, May 2017

The perfect is the enemy of the good: tradeoffs and efficiencies in optimal budget-constrained multi-species corridor networks. *B. Dilkina*, R. Houtman, C. P. Gomes, K. S. McKelvey, C. A. Montgomery, K. Kendall, T. Graves, R. Bernstein, M. K. Schwartz. Conservation Biology (journal), 2016.

Learning Mixtures of Markov Chains from Aggregate Data with Structural Constraints. D. Luo, H. Xu, Y. Zhen, *B. Dilkina*, H. Zha, H., X. Yang, W. Zhang. IEEE Transactions on Knowledge and Data Engineering (TKDE) (journal), 2016.

An Approach to Integrate Inter-Dependent Simulation Using HLA with Applications to Sustainable Urban Development. A. Jain, D. Robinson, *B. Dilkina*, R.M. Fujimoto WSC-16: *Winter Simulation Conference*, 2016.

Firebird: Predicting Fire Risk and Prioritizing Fire Inspections in Atlanta. M. Madaio, S.-T. Chen, O. Haimson, W. Zhang, X. Cheng, M. Hinds-Aldrich, D.H. Chau, *B. Dilkina* KDD-16: *ACM SIGKDD international conference on Knowledge discovery and data mining*, 2016 (oral presentation 8.6%) BEST PAPER Runner Up Award (Applied Data Science Track)

Lexis: An Optimization Framework for Discovering the Hierarchical Structure of Sequential Data. P. Siyari, *B. Dilkina*, C.Dovrolis KDD-16: *ACM SIGKDD international conference on Knowledge discovery and data mining*, 2016 (oral presentation 8.6%)

Active Learning in Multi-objective Evolutionary Algorithms for Sustainable Building Design. S. Safarzaghan Gilan, N. Goyal, *B. Dilkina* GECCO-16: *Genetic and Evolutionary Computation Conference*, 2016.

Learning to Branch in Mixed Integer Programming. E. Khalil, P. Le Bodic, L. Song, G. Nemhauser, and *B. Dilkina*. AAAI-16: *AAAI Conference on Artificial Intelligence*, 2016.

Learning Mixtures of Markov Chains from Aggregate Data with Structural Constraints. D. Luo, H. Xu, Y. Zhen, *B. Dilkina*, H. Zha, H., X. Yang, W. Zhang. IEEE Transactions on Knowledge and Data Engineering (TKDE) journal, 2016.

Learning Large Scale Dynamic Discrete Choice Models of Spatio-Temporal Preferences with Application to Migratory Pastoralism in East Africa. S. Ermon, Y. Xue, R. Toth, *B. Dilkina*, R. Bernstein, T. Damoulas, P. Clark, S. DeGloria, A. Mude, C. Barrett, and C. Gomes. AAAI-15: *AAAI Conference on Artificial Intelligence*, 2015.

Tradeoffs in the complexity of backdoors to satisfiability: dynamic solvers and learning during search. *B. Dilkina*, C. Gomes, A. Sabharwal. Annals of Mathematics and Artificial Intelligence (journal). 70(4): 399-431, 2014.

Scalable Diffusion-Aware Optimization of Network Topology. E. Khalil, *B. Dilkina*, and L. Song. KDD-14: *ACM SIGKDD International Conference on Knowledge Discovery and Data Mining*, 2014

To Gather Together for a Better World: Understanding and Leveraging Communities in Micro-lending Recommendation. J. Choo, D. Lee, *B. Dilkina*, H. Zha and H. Park. WWW-14: *International World Wide Web Conference*, 2014

Improving Your Chances: Boosting Citizen Science Discovery. Y. Xue, B. Dilkina, T. Damoulas, D. Fink, C. P. Gomes and S. Kelling. *HCOMP-13: AAAI Conference on Human Computation and CrowdSourcing*, 2013

Robust Network Design for Multispecies Conservation. R. Le Bras, B. Dilkina, Y. Xue, C. P. Gomes, K. S. McKelvey, C. Montgomery and M. K. Schwartz. *AAAI-13: AAAI Conference on Artificial Intelligence*, pp. 1305-1312, 2013

Large Landscape Conservation - Synthetic and Real-World Datasets. B. Dilkina, K. Lai, R. Le Bras, Y. Xue, C. P. Gomes, A. Sabharwal, J. Suter, K. S. McKelvey, M. K. Schwartz and C. Montgomery. *AAAI-13: AAAI Conference on Artificial Intelligence*, pp. 1369-1372, 2013

Incorporating Computational Sustainability into AI Education through a Freely-Available, Collectively-Composed Supplementary Lab Text (Extended Abstract). D. H. Fisher, B. Dilkina, E. Eaton, C. P. Gomes. *EAAI-12: AAAI Symposium on Educational Advances in Artificial Intelligence*, 2012

Upgrading Shortest Paths in Networks. B. Dilkina, K. Lai, C. P. Gomes. *CPAIOR-11: Intl. Conference on Integration of AI and OR Techniques in Constraint Programming for Combinatorial Optimization Problem*, pp. 79-91, 2011

An Empirical Study of Optimization for Maximizing Diffusion in Networks. K. Ahmadizadeh, B. Dilkina, C. P. Gomes, A. Sabharwal. *CP-10 : Intl. Conference on Principles and Practice of Constraint Programming*, pp. 514-521, 2010

Maximizing Spread of Cascades Using Network Design. D. Sheldon, B. Dilkina, A. Elmachtoub, R. Finseth, A. Sabharwal, J. Conrad, C. P. Gomes, D. Shmoys, W. Allen, O. Amundsen, B. Vaughan. *UAI-10: Conference in Uncertainty in Artificial Intelligence*, pp. 517-526, 2010

Solving Connected Subgraph Problems in Wildlife Conservation. B. Dilkina, C. P. Gomes. *CPAIOR-10: Intl. Conference on Integration of AI and OR Techniques in Constraint Programming for Combinatorial Optimization Problems*, pp. 102-116, 2010

Backdoors in the Context of Learning. B. Dilkina, C. P. Gomes. *SAT-09: Intl. Conference on Theory and Applications of Satisfiability Testing*, pp. 73-79, 2009

Backdoors to Combinatorial Optimization: Feasibility and Optimality. B. Dilkina, C. P. Gomes, Y. Malitsky, A. Sabharwal, M. Sellmann. *CPAIOR-09: Intl. Conference on Integration of AI and OR Techniques in Constraint Programming for Combinatorial Optimization Problems*, pp. 56-70, 2009

Tradeoffs in the Complexity of Backdoor Detection. B. Dilkina, C. P. Gomes, A. Sabharwal. *CP-07: Intl. Conference on Principles and Practice of Constraint Programming*, pp. 256-270, 2007

The Impact of Network Topology on Pure Nash Equilibria in Graphical Games. B. Dilkina, C. P. Gomes, A. Sabharwal. *AAAI-07: Conference on Artificial Intelligence*, pp. 42-49, 2007. *Nominated BEST PAPER AWARD*

Extending Systematic Local Search for Job Shop Scheduling Problems. B. Dilkina, L. Duan and W. S. Havens. *CP-05: Intl. Conference on Principles and Practice of Constraint Programming*, 2005

Scheduling the National Football League Season. B. Dilkina, and W. S. Havens. *IAAI-04: Innovative Applications in Artificial Intelligence*, 2004

A Hybrid Schema for Systematic Local Search. W. S. Havens and B. Dilkina. *AI-04: Canadian Conference on Artificial Intelligence*, 2004

WORKSHOPS &
OTHER
NON-ARCHIVAL
WORK

Learning Combinatorial Optimization Algorithms over Graphs. Dai, H.; Khalil, E. B.; Zhang, Y.; *Dilkina, B.*; and Song, L. arXiv preprint arXiv:1704.01665, 2017.

Network Optimization of Food Flows in the U.S.. C. Robinson, A. Shirazi, M. Liu, *B. Dilkina*. 2nd International Workshop on Big Data for Sustainable Development at IEEE International Conference on Big Data, 2016.

Interactive tool to prioritize housing options for refugee resettlement. U. Ahsan, O. Sopova, W. Stayton, *B. Dilkina*. Bloomberg Data for Good Exchange, Sept. 2016.

Helping to Preserve Atlanta’s Urban Tree Canopy. J. Belknap, C. Foster, S. Moningi, A. Beasley, A. Giarrusso, *B. Dilkina*. Bloomberg Data for Good Exchange, Sept. 2015.

Identifying and Prioritizing Fire Inspections: A Case Study of Predicting Fire Risk in Atlanta. Madaio, M., Haimson, O., Zhang, W., Cheng, X., Hinds-Aldrich, M., *Dilkina, B.*, Chau, D.H. Bloomberg Data for Good Exchange, Sept. 2015.

Protecting landscape connectivity for species persistence in the face of urbanization and climate change. *B. Dilkina*. 2015 International Workshop to Explore Research Frontiers through US Engagement in the Lower Mekong Basin (US/LMB 2015), organized by NSF.

Learning-to-Branch in Mixed Integer Programming. Elias Khalil, *Bistra Dilkina*, and Le Song. Mixed Integer Programming Workshop, June 2015.

Optimization Approaches for Pedestrian Connectivity. *Bistra Dilkina*. NSF Early-Career Investigators Workshop on CPS and Smart City (includes a stipend award of \$1,500), Apr. 2015.

Sustainable Building Design: a Challenge at the Intersection of Machine Learning and Design Optimization. Siamak Safarzadegan Gilan and *Bistra Dilkina*. AAAI Workshop on Computational Sustainability, Jan. 2015.

Coarse models for bird migrations using clustering and non-stationary Markov chains. Nitin Jain and *Bistra Dilkina*. AAAI Workshop on Computational Sustainability, Jan. 2015.

CuttingEdge: Influence minimization in networks (Best student paper award). Elias Khalil, *Bistra Dilkina*, and Le Song. NIPS Workshop: Frontiers of Network Analysis: Methods, Models, and Applications, 2013. *Best Paper Award*

AL2: Learning for Active Learning. *B. Dilkina*, T. Damoulas, C. P. Gomes, D. Fink. NIPS Workshop: Machine Learning for Sustainability, 2011

A Framework for Designing and Evaluating Mixed-Initiative Optimization Systems. A. E. Kirkpatrick, *B. Dilkina*, and W. S. Havens. Workshop on Mixed-Initiative and Planning at ICAPS, 2005

SELECTED
TALKS/SEMINARS

Challenges in Computational Sustainability
University of South California, Computer Science Colloquium, March 2017

KEYNOTE: Learning to Branch in Mixed Integer Programming
Learning and Intelligent Optimization Conference (LION), May 2016

Machine Learning for Branch and Bound Search
Clemson University, CS Seminar, Oct. 2016

Cornell University, AI Seminar, Apr. 2016

Network Design Approaches to Biodiversity Conservation

Emory University, Population Biology, Ecology and Evolution Seminar, Apr. 2017

Clemson University, Industrial Engineering Distinguished Researcher Seminar Series, Aug. 2016

Shifting habitats in response to changing climate in the Southeastern U.S.

US-IALE: Annual Conference of the U.S. Regional Association of the International Association for Landscape Ecology, Apr. 2016

Learning to branch for Mixed Integer Programming

Sandia National Lab. Host Jean Paul Watson. Dec. 2015

Discrete Optimization Seminar at ISYE, Georgia Tech. Oct. 2015

Soundscaping Urban Infrastructure for Predictive Maintenance

Global City Teams Challenge Expo, Washington, DC, June 2015

Optimization Approaches for Large Landscape Connectivity

Southeast Climate Science Center, Raleigh, NC, May 2015

Optimization Approaches for Conservation Planning

Invited seminar at the Warnell School of Forestry and Natural Resources, University of Georgia, Feb. 2015

Applications of graph theory to optimize wildlife corridor systems for multiple species: Grizzly bear and wolverines in the northern Rockies, with C. Montgomery, OSU

American Math Society Joint Math Meeting, Jan. 2014

Network Design Problems in Landscape Connectivity Conservation

NIPS Workshop on Machine Learning for Sustainability, Dec 2013

Optimization Approaches for Conservation Planning

Oak Ridge National Lab, Nov 2013

Computational advances in cost-effective large-scale conservation planning

University of California Santa Cruz, April 2013

Challenges in Computational Sustainability

CS Colloquium, Stony Brook University, April 2013

Challenges in Computational Sustainability

CSE Seminar, Georgia Institute of Technology, Feb 2013

Robust Network Design for Multispecies Conservation

INFORMS Annual Meeting, Phoenix, AZ, 2012

PATENTS AND
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US Patent 8554519: *Method for designing the layout of turbines in a windfarm.* B. Dilkina, J. Kalagnanam, E. Novakovskaia. Assignee: IBM Corp. Granted Oct 8, 2013.

US Patent 7606776: *Flexible Constraint Propagation Engine for Combinatorial Optimization Problems.* W. S. Havens and B. Dilkina. Assignee: Actenum Corp. Granted Oct 20, 2009.

TEACHING

Instructor

Fall 2014, Fall 2015, Fall 2016

Graduate course *CSE6140: CSE Algorithms*
Georgia Institute of Technology

Instructor

Spring 2014, Spring 2015, Spring 2016

Graduate course *CSE8803: Computational Sustainability*

Georgia Institute of Technology

Tutorial Presenter

2012

Master class at International Conference on Computational Sustainability
Copenhagen, Denmark.

ACADEMIC
SERVICE

Organizer

- co-Chair of Special Track on Computational Sustainability at AAAI Conference on Artificial Intelligence 2016 and 2017
- co-Director of Data Science for Social Good - Atlanta, summer research program 2015, 2016, 2017
- co-Chair of AAAI Workshop on Computational Sustainability, at AAAI Conference on Artificial Intelligence 2015
- publicity chair CPAIOR: Intl. Conference on Integration of AI and OR Techniques in Constraint Programming 2013
- Chair of CROCS: International Workshop on Constraint Reasoning and Optimization for Computational Sustainability 2012
- co-Chair of NESCAI: North East Student Colloquium on Artificial Intelligence 2008

Program Committee member

- IJCAI: International Joint Conference on Artificial Intelligence; KDD: ACM SIGKDD Conference on Knowledge Discovery and Data Mining; AAAI Conference on Artificial Intelligence; CPAIOR: Intl. Conference on Integration of AI and OR Techniques in Constraint Programming; CompSust: International Conference on Computational Sustainability; LION: Learning and Intelligent Optimization Conference; CP: International Conference on Constraint Programming

Journal Reviewer

- Operations Research (OR) journal; IEEE Transactions of Knowledge and Data Engineering (TKDE) journal; European Journal of Operational Research; EURO Journal on Computational Optimization; INFORMS Journal of Computing; Annals of Mathematics and AI; IEEE Transactions on Computers

RESEARCH AND
DEVELOPMENT
EXPERIENCE

Institute for Computational Sustainability, Ithaca, NY **Aug 2011-Jul 2013**

- Title: *Postdoctoral Associate*

IBM Research T.J. Watson, Yorktown Heights, NY **Sept 2009-Aug 2010**

- Title: *Graduate intern* (Mentors: Jayant Kalagnanam and Andrew Conn)

IBM Research T.J. Watson, Yorktown Heights, NY **June 2009-Aug 2009**

- Title: *Graduate intern* (Mentors: Jayant Kalagnanam and Andrew Davenport)

Intelligent Information Systems Institute, Ithaca, NY **2005-2008**

- Title: *Research Assistant for Carla Gomes*

Actenum Corporation, Vancouver, BC **2004-2006**

- Title: *Full time Senior Research Scientist*

Constraint Works Inc., Vancouver, BC **2002**

- Title: *COOP/Intern*