Haihao (Sean) Lu

CONTACT INFORMATION	Email: haihao.lu@chicagobooth.edu Phone: 857-998-3092 Web: web.mit.edu/haihao/www/

RESEARCH INTERESTS

Large-scale optimization, machine learning and data-driven applications.

ACADEMIC APPOINTMENT

University of Chicago, Chicago, IL　　　　　　　　　　July 2020-present
Booth School of Business
Assistant Professor of Operations Management

EDUCATION

Massachusetts Institute of Technology, Cambridge, MA　　　2014-2019
Ph.D. Dual in Operations Research & Applied Mathematics,
Thesis Title: Large-Scale Optimization Methods for Data-Science Applications
Advisor: Prof. Robert M. Freund
Thesis Committee Members: Robert M. Freund, Rahul Mazumder, Ankur Moitra, Jonathan Kelner

Shanghai Jiao Tong University, Shanghai, China　　　　　2010-2014
B.S. in Applied Mathematics, Zhiyuan College, Graduation with distinction
Advisor: Prof. David Cai

PAPERS UNDER REVIEW

"Approximate Leave-One-Out for High-Dimensional Non-Differentiable Learning Problems", Shuaiwen Wang, Wenda Zhou, Arian Maleki, Haihao Lu and Vahab Mirrokni, submitted.

"An $O(s^r)$-Resolution ODE Framework for Discrete-Time Optimization Algorithms and Applications to Convex-Concave Saddle-Point Problems", Haihao Lu, submitted.

"Contextual Reserve Price Optimization in Auctions", Joey Huchette, Haihao Lu, Hossein Esfandiari and Vahab Mirrokni, submitted.

"Regularized Online Allocation Problems: Fairness and Beyond", Benjamin Grimmer, Haihao Lu, Pratik Worah and Vahab Mirrokni, submitted.

"The Landscape of Nonconvex-Nonconcave Minimax Optimization", with Santiago Balseiro and Vahab Mirrokni, submitted.

JOURNAL PUBLICATIONS (REVERSE CHRONOLOGICAL ORDER)

"Randomized Gradient Boosting Machines", Haihao Lu and Rahul Mazumder, to appear in *SIAM Journal on Optimization*.

"Generalized Stochastic Frank-Wolfe Algorithm with Stochastic 'Substitute' Gradient for Structured Convex Optimization", Haihao Lu and Robert M. Freund, to appear in *Mathematical Programming*.

" 'Relative-Continuity' for Non-Lipschitz Non-Smooth Convex Optimization using Stochastic (or Deterministic) Mirror Descent", Haihao Lu, *INFORMS Journal on Optimization*, 2019, 1(4): 288-303.

"Relatively-Smooth Convex Optimization by First-Order Methods, and Applications", Haihao Lu, Robert M. Freund and Yurii Nesterov, *SIAM Journal on Optimization*, 2018, 28(1): 333-354.

"New Computational Guarantees for Solving Convex Optimization Problems with First Order Methods, via a Function Growth Condition Measure", Robert M. Freund, Haihao

Lu, *Mathematical Programming* 2018, Vol.170, No.2: 445-477.

"Stochastic Linearization of β-Fermi-Pasta-Ulam Dynamics in Equilibrium and Non-equilibrium State", Shi-xiao W. Jiang, Haihao Lu, Douglas Zhou, and David Cai, *New Journal of Physics*, 2016, 18(8): 083028.

"Renormalized Dispersion Relations of β-Fermi-Pasta-Ulam Chains in Equilibrium and Nonequilibrium states", Shi-xiao W. Jiang, Haihao Lu, Douglas Zhou, and David Cai. *Physical Review E*, 2014, 90(3): 032925.

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<td>CONFERENCE PUBLICATIONS (REVERSE CHRONOLOGICAL ORDER)</td>
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"Dual Mirror Descent for Online Allocation Problems", with Santiago Balseiro and Vahab Mirrokni, *ICML*, 2020.
"Accelerating Gradient Boosting Machines", Haihao Lu, Sai Praneeth Karimireddy, Natalia Ponomareva and Vahab Mirrokni, *AISTATS*, 2020.

"A Stochastic First-Order Method for Ordered Empirical Risk Minimization", Kenji Kawaguchi and Haihao Lu, *AISTATS*, 2020.

"Accelerating Greedy Coordinate Descent Methods", Haihao Lu, Robert M. Freund and Vahab Mirrokni, *ICML*, 2018.

"Approximate Leave-One-Out for Fast Parameter Tuning in High Dimensions", Shuaiwen Wang, Wenda Zhou, Haihao Lu, Arian Maleki, Vahab Mirrokni, *ICML*, 2018.
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<td>TECHNICAL REPORTS</td>
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"Depth Creates No Bad Local Minima", Haihao Lu and Kenji Kawaguchi, *Technical Report.*
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WORKING EXPERIENCE

Google Research, New York City, NY   July 2019-June 2020
Visiting Researcher
Manager: Vahab Mirrokni
I continue working on the huge-scale Linear Programming solver at Google.

Google Research, Cambridge, MA   Oct 2018-April 2019
Student Researcher
Mentor: Miles Lubin, Natalia Ponomareva
Expanding the project on the huge-scale Linear Programming solver. Developing and implementing the Accelerated Gradient Boosting Machine with CART trees.

Google Research, New York City, NY   Summer 2018
Research Intern
Mentor: Miles Lubin, David Applegate
Designed and implemented a huge-scale Linear Programming solver using first-order methods. The solver was able to solve a Linear Programming problem with multi-billion non-zeros on a single machine, and could be implemented distributedly across thousands of machines.

Google Inc, New York City, NY   Summer 2017
Software Engineer Intern
Mentor: Vahab Mirrokni, Vineet Kahlon
Developed new machine learning models for reserve price optimization of display ads (DRX), which gained a 2.7% revenue lift compared with the production model. The models were put on production in 2018Q2.

IBM T.J.Watson Research Center, Yorktown Heights, NY   Summer 2016

Research Intern
Mentor: Andrew Conn
Developed new distributed optimization methods to solve deep learning problems, conducted extensive computational testing on preliminary tasks.

TEACHING EXPERIENCE	**Massachusetts Institute of Technology**

Teaching Assistant
- 18.S096 Computational Statistics (Undergraduate), Fall 2017
- 15.093J/6.255J Optimization Methods (MBAn Core), Fall 2016
- 15.084J/6.252J Nonlinear Optimization (PhD), Spring 2016

Sloan Masters' in Business Analytics (MBAn) Mentor
- Mentor for MBAn student team "Capstone Project" with McKinsey & Company, Spring 2018

PRESENTATIONS

Accelerated Gradient Boosting Machines
- International Conference on Artificial Intelligence and Statistics, August 2020

An $O(s^r)$-Resolution ODE Framework for Discrete-Time Optimization Algorithms and Applications to Minimax Problems
- Google Research NYC, June 2020
- SIAM Conference on Mathematics of Data Science, June 2020

Ordered-SGD: A New Stochastic Optimization Framework for Empirical Risk Minimization
- International Conference on Artificial Intelligence and Statistics, Web, August 2020
- International Conference on Continuous Optimization, Berlin, August 2019
- Google Research, New York City, Sep 2019
- Rensselaer Polytechnic Institute, Mathematics Department, Nov 2019
- NYU, Courant Institute of Mathematical Science, Nov 2019

Gradient Boosting Machines: New Insights, Algorithms, and Improved Complexity
- National University of Singapore, ISEM, January 2019
- University of Toronto, Mathematics and Computer Science, January 2019
- University of Toronto, MIE, January 2019
- University of Chicago, Booth, January 2019
- University of Minnesota, Twin Cities, ISE, January 2019
- Duke University, Mathematics and Computer Science, January 2019
- Columbia University, IEOR, February 2019
- University of Wisconsin, Madison, ISE, February 2019
- University of Illinois, Urbana-Champaign, ISE, February 2019
- Google Research, Cambridge, February 2019
- Google Research, New York City, March 2019

Randomized Gradient Boosting Machines
- INFORMS Annual Meeting, Phoenix, November 2018

Scalable Linear Programming via First-Order Methods
- Princeton Optimization Day (Poster), Princeton, September 2018
- Google Research, New York City, August 2018

Generalized Stochastic Frank-Wolfe Algorithm with Stochastic 'Substitute' Gradient for Structured Convex Optimization
- Columbia University, Statistics Department, August 2018

- International Symposium on Mathematical Programming (ISMP), Bordeaux, July 2018

Accelerating Greedy Coordinate Descent Methods
- Google Research, New York City, July 2018
- International Conference on Machine Learning, Stockholm, July 2018
- NYAS Meeting on Machine Learning (Poster), New York City, March 2018

Approximate Leave-One-Out for Fast Parameter Tuning in High Dimensions
- International Conference on Machine Learning (Poster), Stockholm, July 2018
- NYAS Meeting on Machine Learning (Poster), New York City, March 2018

"Relative-Continuity" for Non-Lipschitz Non-Smooth Convex Optimization using Stochastic (or Deterministic) Mirror Descent
- INFORMS Meeting on Optimization, Denver, March 2018
- INFORMS Annual Meeting, Houston, Oct 2017

Relatively-Smooth Convex Optimization by First-Order Methods, and Applications
- SIAM Conference on Optimization, Vancouver, May 2017
- INFORMS Annual Meeting, Nashville, November 2016

Extending the Scope of 'Smooth' and 'Non-Smooth' Convex Optimization via First-Order Methods
- University of Edinburgh, Edinburgh, UK, April 2016

Some New Results for Randomized Coordinate Gradient Descent
- International Symposium on Mathematical Programming (ISMP), Pittsburg, July 2015

ACADEMIC SERVICE

Reviewer for Journals: *Mathematical Programming*, *SIAM Journal on Optimization*, *Mathematics of Operations Research*, *Journal of Machine Learning Research* (editorial board reviewer), *IEEE Transactions on Image Processing*, *Computational Optimization and Applications*.
Reviewer for Conferences: *NeurIPS* 2019, *WebConf* 2019, *ICML* 2020, *NeurIPS* 2020.

MISCELLANEOUS

Computing: Python, Julia, C++, R, SQL
Hobbies: Food/Cuisine, Kayaking, Sailing, Hiking, Skiing