Zihao Hu

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Research Focus

Machine Learning Theory, Convex Optimization, Riemannian Optimization, Algorithmic Game Theory, Online Decision Making

Education

- **Georgia Institute of Technology** — Atlanta, USA
  PhD Candidate in Machine Learning; Advisor: Jacob Abernethy — *Aug. 2018 - Dec. 2023 (anticipated)*
  Courses: Math Foundations of ML, Machine Learning Theory, Theoretical Statistics, Nonlinear Optimization, Graphical Models in ML.

- **Shanghai Jiao Tong University** — Shanghai, China
  M.S. in Computer Science; Advisor: Hongtao Lu; GPA: 3.89/4.00, Rank: 3/115 — *Mar. 2018*

- **Huazhong University of Science and Technology** — Wuhan, China
  BSEE in Telecommunications; GPA: 84.55/100 — *June 2015*

Publications

- **Zihao Hu**, Guanghui Wang, Xi Wang, Andre Wibisono, Jacob Abernethy, Molei Tao. Extragradient Type Methods for Riemannian Variational Inequality Problems. arXiv: 2309.14155.

- **Zihao Hu**, Guanghui Wang, Jacob Abernethy. On Riemannian Projection-free Online Learning. Accepted by Conference on Neural Information Processing Systems (NeurIPS) 2023.

- Guanghui Wang, **Zihao Hu**, Vidya Muthukumar, Jacob Abernethy. Faster Margin Maximization Rates for Generic Optimization Methods. Accepted by Conference on Neural Information Processing Systems (NeurIPS) 2023. (Spotlight)

- **Zihao Hu**, Guanghui Wang, Jacob Abernethy.Minimizing Dynamic Regret on Geodesic Metric Spaces. Annual Conference on Learning Theory (COLT) 2023.

- Guanghui Wang, **Zihao Hu**, Vidya Muthukumar, Jacob Abernethy. Adaptive Oracle-Efficient Online Learning. Conference on Neural Information Processing Systems (NeurIPS) 2022.

- **Zihao Hu**, Junxuan Chen, Hongtao Lu, Tongzhen Zhang. Bayesian Supervised Hashing. Conference on Computer Vision and Pattern Recognition (CVPR) 2017. (Spotlight, 8%)

- Wei Shen, Xiang Bai, **Zihao Hu**, Zhijiang Zhang. Multiple Instance Subspace Learning via Partial Random Projection Tree for Local Reflection Symmetry in Natural Images. Pattern Recognition (PR) 2016.

Experience

- **Georgia Institute of Technology** — Atlanta, GA
  Research Assistant — *Aug. 2018 - Present*
  - **Extragradient Type Methods for Riemannian Variational Inequality Problems**:
    - Developed and introduced REG and RPEG as pioneering first-order approaches to Riemannian variational inequality problems.
    - Secured an unprecedented $O\left(\frac{1}{\sqrt{T}}\right)$ last-iterate convergence rate for Riemannian extragradient-type methods.
    - Effectively addressed geometric distortion by meticulously controlling the holonomy effect, subsequently simplifying the issue to its Euclidean counterpart.
  - **Projection-free Online Learning on Riemannian Manifolds**:
    - Conducted groundbreaking research on projection-free online learning on Riemannian manifolds, replacing metric projection with a linear optimization oracle or a separation oracle.
    - Successfully matched state-of-the-art results in Euclidean space, demonstrating the robustness and effectiveness of the new methodology.

- **Optimistic Online Learning on Riemannian Manifolds**:
  - Extended the Optimistic Mirror Descent algorithm to Riemannian manifolds in the online improper learning setting through innovative analysis.
  - Considered the aggregation of experts' advice on manifolds and devised novel algorithms with adaptive and dynamic regret guarantees.
  - Achieved regret bounds that align with their counterparts in Euclidean space, validating the effectiveness of the newly developed algorithms.
- **Adaptive Oracle-Efficient Online Learning**:
  - Concentrated on enhancing oracle-efficient online learning, which utilizes an offline oracle to expedite computation.
  - Applied Follow the Perturbed Leader with correlated noise and established a novel condition to attain the first-order bound.
  - Demonstrated the applicability of the condition for various online auction problems, including VCG auction with reserves, envy-free k-item pricing, and level auctions.

- **Shanghai Jiao Tong University**   Shanghai, China
  Master Student   *Sept. 2015 - Mar. 2018*
  - **Bayesian Supervised Hashing for Hyperparameter Tuning**:
    - Introduced the first Bayesian inference approach for automatic hyperparameter tuning in learning binary hashing codes, significantly reducing the dependency on manual tuning prevalent in prior methods.
    - Employed Automatic Relevance Determination (ARD) prior to discern the relative importance of different hashing bits, enhancing model performance.
  - **Two Sigma Financial Modeling Challenge**:
    - Developed a predictive model for a target variable associated with near-future fluctuations suggested by the VIX index, leveraging anonymized features derived from financial instruments.
    - Merged linear regression and genetic programming models with extremely randomized trees, fostering an effective and reliable predictive model.
    - Achieved a ranking in the top 7.15% (148 out of 2070 participants) in the final evaluation, underscoring the model's accuracy and effectiveness.

Honors and Awards

- National Scholarship 2017, Shanghai Jiao Tong University, Shanghai, China (Top 2.6%, 3/115)

- Two Sigma Financial Modeling Challenge 2017, Kaggle (Top 7.15%, 148/2070)

- First Prize in China Post-Graduate Mathematical Contest in Modeling 2016 (Top 1.69%, 150/8872)

Skills Summary

- **Languages**: C, C++, Python, Shell Script
- **Tools**: Linux, Git, Mathematica, Matlab

References

- Prof. Jacob Abernethy (Ph.D. Advisor)

  - Associate Professor in School of Computer Science, Georgia Institute of Technology

  - Email: prof@gatech.edu

  - Homepage: https://faculty.cc.gatech.edu/~jabernethy9/

- Prof. Molei Tao

  - Associate Professor in School of Mathematics, Georgia Institute of Technology

  - Email: mtao@gatech.edu

  - Homepage: https://mtao8.math.gatech.edu/

- Prof. Andre Wibisono
  - Assistant Professor in Department of Computer Science, Yale University
  - Email: andre.wibisono@yale.edu
  - Homepage: http://www.cs.yale.edu/homes/wibisono/