

## RESEARCH INTERESTS

I am currently working on developing principled data-efficient reinforcement learning with human feedback (RLHF) for fine-tuning large language models (LLMs). I am also interested in fundamental research on reinforcement learning and multi-armed bandits.

## EDUCATIONS

<b>Ph.D. in Statistics</b> Department of Statistics, Purdue University Thesis Advisor: Dr. Guang Cheng	Sep. 2014 - Dec. 2019
<b>B.S. in Statistics</b> School of Mathematics, Nankai University	Sep. 2010 - Aug. 2014

## PROFESSIONAL EXPERIENCES

<b>▲ Deepmind</b> <i>Senior Research Scientist</i>	Nov. 2020 - Present
<b>▲ Princeton University</b> <i>Postdoctoral Researcher</i> Mentor(s): Dr. Mengdi Wang	Dec. 2019 - Nov. 2020
<b>▲ Deepmind</b> <i>Research Intern</i>	May 2019 - Sep. 2019
<b>▲ Adobe Research</b> <i>Research Intern</i>	May 2018 - Aug. 2018

## JOURNAL PUBLICATIONS

- ▲ Sparse Tensor Additive Regression**  
**Botao Hao**, Boxiang Wang, Pengyuan Wang, Emma Jingfei Zhang, Jian Yang, Will Wei Sun  
*Journal of Machine Learning Research* (2021). [[ArXiv](#)]
- ▲ Sparse and Low-rank Tensor Estimation via Cubic Sketchings**  
**Botao Hao**, Anru Zhang, and Guang Cheng  
*IEEE Transactions on Information Theory* (2020). [[ArXiv](#)]
- ▲ Nonparametric Bayesian Aggregation for Massive Data**  
Zuofeng Shang, **Botao Hao**, and Guang Cheng  
*Journal of Machine Learning Research* (2019). [[ArXiv](#)]
- ▲ Simultaneous Clustering and Estimation of Heterogeneous Graphical Models**  
**Botao Hao**, Will Wei Sun, Yufeng Liu, and Guang Cheng  
*Journal of Machine Learning Research* (2018). [[ArXiv](#)]

## CONFERENCE PUBLICATIONS

- ▲ Leveraging Demonstrations to Improve Online Learning: Quality Matters**  
**Botao Hao**, Rahul Jain, Tor Lattimore, Benjamin Van Roy, Zheng Wen  
*ICML 2023*. [[ArXiv](#)]
- ▲ Regret Bounds for Information-Directed Reinforcement Learning**

**Botao Hao**, Tor Lattimore  
*NeurIPS 2022*. [[ArXiv](#)]

▲ **The Neural Testbed: Evaluating Predictive Distributions**

Ian Osband, Zheng Wen, Mohamammad Asghari, Vikranth Dwaracherla, **Botao Hao**,  
Morteza Ibrahimi, Dieterich Lawson, Xiuyuan Lu, Brendan O'Donoghue, Benjamin Van Roy  
*NeurIPS 2022*. [[ArXiv](#)][[GitHub](#)]

▲ **Contextual Information-Directed Sampling**

**Botao Hao**, Tor Lattimore, Chao Qin  
*ICML 2022*. [[ArXiv](#)]

▲ **Interacting Contour Stochastic Gradient Langevin Dynamics**

Wei Deng, Siqi Liang, **Botao Hao**, Guang Lin, Faming Liang  
*ICLR 2022*. [[OpenReview](#)]

▲ **Confident Least Square Value Iteration with Local Access to a Simulator**

**Botao Hao**, Nevena Lazic, Dong Yin, Yasin Abbasi-Yadkori, Csaba Szepesvári  
*AISTATS 2022*. [[ArXiv](#)]

▲ **Efficient Local Planning with Linear Function Approximation**

Dong Yin, **Botao Hao**, Yasin Abbasi-Yadkori, Nevena Lazic, Csaba Szepesvári  
*ALT 2022*. [[ArXiv](#)]

▲ **Bandit Phase Retrieval**

Tor Lattimore, **Botao Hao**  
*NeurIPS 2021*. [[ArXiv](#)]

▲ **Information Directed Sampling for Sparse Linear Bandits**

**Botao Hao**, Tor Lattimore, Wei Deng  
*NeurIPS 2021 (spotlight)*. [[ArXiv](#)]

▲ **Bootstrapping Statistical Inference for Off-Policy Evaluation**

**Botao Hao**, Xiang Ji, Yaqi Duan, Hao Lu, Csaba Szepesvári, Mengdi Wang  
*ICML 2021*. [[ArXiv](#)]

▲ **Sparse Feature Selection Makes Batch Reinforcement Learning More Sample Efficient**

**Botao Hao**, Yaqi Duan, Tor Lattimore, Csaba Szepesvári, Mengdi Wang  
*ICML 2021*. [[ArXiv](#)]

▲ **Online Sparse Reinforcement Learning**

**Botao Hao**, Tor Lattimore, Csaba Szepesvári, Mengdi Wang  
*AISTATS 2021*. [[ArXiv](#)]

▲ **Adaptive Approximate Policy Iteration**

**Botao Hao**, Nevena Lazic, Yasin Abbasi-Yadkori, Pooria Joulani, Csaba Szepesvári  
*AISTATS 2021*. [[ArXiv](#)]

▲ **High-Dimensional Sparse Linear Bandits**

**Botao Hao**, Tor Lattimore, Mengdi Wang  
*NeurIPS 2020*. [[ArXiv](#)]

▲ **Adaptive Exploration in Linear Contextual Bandit**

**Botao Hao**, Tor Lattimore, and Csaba Szepesvári  
*AISTATS 2020*. [[ArXiv](#)]

▲ **Sparse and Low-rank Tensor Estimation via Cubic Sketchings**

**Botao Hao**, Anru Zhang, and Guang Cheng

AISTATS 2020. [[Link](#)]

▲ **Bootstrapped Upper Confidence Bound**

**Botao Hao**, Yasin Abbasi-Yadkori, Zheng Wen, and Guang Cheng

NeurIPS 2019. [[ArXiv](#)]

## BOOK CHAPTERS

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▲ **Tensors in Modern Statistical Learning**

Will Wei Sun, **Botao Hao**, Lexin Li

In *Wiley StatsRef: Statistics Reference Online*. [[Link](#)]

## PREPRINTS

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▲ **Sequential Best-Arm Identification with Application to Brain-Computer Interface**

Xin Zhou, **Botao Hao**, Jian Kang, Tor Lattimore, Lexin Li

Submitted. [[ArXiv](#)]

▲ **Bridging Imitation and Online Reinforcement Learning: An Optimistic Tale**

**Botao Hao**, Rahul Jain, Dengwang Tang, Zheng Wen

Accepted with minor revision at *Transactions on Machine Learning Research*. [[ArXiv](#)]

▲ **Sample Efficient Deep Reinforcement Learning via Local Planning**

Dong Yin, Sridhar Thiagarajan, Nevena Lazic, Nived Rajaraman, **Botao Hao**, Csaba Szepesvari

Submitted to *Journal of Machine Learning Research*. [[ArXiv](#)]

▲ **Optimization Issues in KL-Constrained Approximate Policy Iteration**

Nevena Lazic, **Botao Hao**, Yasin Abbasi-Yadkori, Dale Schurmans, Csaba Szepesvári

Preprint. [[ArXiv](#)]

▲ **Stochastic Low-rank Tensor Bandits for Multi-dimensional Online Decision Making**

Jie Zhou, **Botao Hao**, Zheng Wen, Jingfei Zhang, Will Wei Sun

Major revision at *Journal of the American Statistical Association*. [[ArXiv](#)]

▲ **Residual Bootstrap Exploration for Bandit Algorithms**

Chi-Hua Wang\*, Yang Yu\*, **Botao Hao**, Guang Cheng

Preprint. [[ArXiv](#)]

## HONORS AND AWARDS

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▲ AISTATS 2022 Top Reviewer

▲ NeurIPS 2019 Travel Award

▲ Bilsland Dissertation Fellowship

2019-2020

## INVITED TALKS

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▲ Department of Statistics and Probability, Michigan State University

Oct. 2023

▲ CMStatistics 2022, London, UK

Dec. 2022

▲ RL Forum, Stanford University, CA

Nov. 2022

▲ Deepmind for Google, Mountain View, CA

Jan. 2020

▲ Institute of Statistics, Nankai University, Tianjin

Dec. 2018

▲ International Conference on Data Science, Shanghai

Dec. 2017

▲ The 25th ICSA Applied Statistics Symposium, Chicago

Jun. 2017

▲ Conference on Statistical Learning and Data Science, Chapel Hill, NC

Jun. 2016

## SERVICES

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▲ Session chair for Machine Learning/Intelligence Cluster at 2020 INFORMS annual meeting

▲ Co-chair of Ubicomp 2019 Workshop on [Continual and Multimodal Learning for Internet of Things](#), London, UK

▲ Reviewers for Journals:

Annals of Statistics

Annals of Applied Probability

Journal of the American Statistical Association

Journal of Machine Learning Research

Journal of Multivariate Analysis

Computational Statistics and Data Analysis

The IEEE Control Systems Letters

Statistica Sinica

Biostatistics

IEEE Transactions on Information Theory

IEEE Journal on Selected Areas in Information Theory

Transactions on Pattern Analysis and Machine Intelligence

Artificial Intelligence

Transactions on Machine Learning Research

▲ Reviewers for Conferences: NeurIPS, ICML, ICLR, AISTATS, AAAI, UAI, SODA