

KARAN SINGH

PERSONAL INFORMATION

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RESEARCH INTERESTS

Theoretical and applied Machine Learning, with a focus on **Reinforcement Learning** and **Dynamical Systems**. Generative Models, Online Learning, Learning with Partial Feedback, Optimization.

EDUCATION

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|--|---|--|
| | 2015-Present | PRINCETON UNIVERSITY |
| PhD Candidate in Computer Science | GPA: 4.0 · PhD Candidate · Computer Science | |
| Reinforcement Learning, Dynamical Systems | My research is focused on algorithms for machine learning with <i>provable guarantees</i> on computational and statistical efficiency, with an attentive emphasis on interactive learning algorithms . My prior research efforts have yielded provable methods for learning Linear Dynamical Systems (Spotlight at NIPS 2017, Oral at NIPS 2018) and designing controls for the same, despite the non-convex nature of the maximum likelihood problem. My recent works seek to address issues concerning exploration in Reinforcement Learning and those that arise when dealing with continuous state and action spaces. | |
| | Advisor: Prof. Elad HAZAN | |
| | 2011-2015 | INDIAN INSTITUTE OF TECHNOLOGY, KANPUR |
| Bachelor of Technology, Computer Science | GPA: 10.0 · Bachelor of Technology · Computer Science | |
| Ranked 1 st (among 820 students) | Following a rigorous introduction to computer systems and engineering, my coursework included 12 graduate-level courses on theoretical computer science, machine learning, and mathematics. My senior thesis details sketch-based algorithms for machine learning, and lower bounds in the streaming model. | |
| | Awarded the President's Gold Medal for the best academic performance in the graduating class among all disciplines. | |

PUBLICATIONS

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|---------------------------------------|--|
| Preprint | Elad Hazan, Sham Kakade, Karan Singh , Abby Van Soest. Provably Efficient Maximum Entropy Exploration. |
| Preprint | Naman Agarwal, Brian Bullins, Elad Hazan, Sham Kakade, Karan Singh . Online Control with Adversarial Disturbances. |
| NIPS 2018 Oral Presentation | Elad Hazan, Holden Lee, Karan Singh , Cyril Zhang and Yi Zhang. Spectral Filtering for General Linear Dynamical Systems. In the <i>Advances in Neural Information Processing Systems 31 (NIPS)</i> , 2018. |
| ICLR 2018 Workshop | Sanjeev Arora, Elad Hazan, Holden Lee, Karan Singh , Cyril Zhang and Yi Zhang. Towards Provable Control for Unknown Linear Dynamical Systems. <i>International Conference on Learning Representations, Workshop Track</i> , 2018. |
| Non-convex Workshop, ICML 2018. | Naman Agarwal, Brian Bullins, Xinyi Chen, Elad Hazan, Karan Singh , Cyril Zhang and Yi Zhang. The Case for Full-Matrix Adaptive Regularization. <i>International Conference on Machine Learning, Non-convex Workshop</i> , 2018. |
| NIPS 2017 Spotlight | Elad Hazan, Karan Singh and Cyril Zhang. Learning Linear Dynamical Systems via Spectral Filtering. In the <i>Advances in Neural Information Processing Systems 30 (NIPS)</i> , 2017. |
| ICML 2017 | Naman Agarwal and Karan Singh . The Price of Differential Privacy for Online |

Learning. In the *Proceedings of the 34th International Conference on Machine Learning (ICML)*, 2017. [PDF](#)

ICML 2017

Elad Hazan, **Karan Singh** and Cyril Zhang. Efficient Regret Minimization in Non-Convex Games. In the *Proceedings of the 34th International Conference on Machine Learning (ICML)*, 2017. [PDF](#)

DEML Workshop,
ICML 2016

Irineo Cabrereros, **Karan Singh** and Angela Zhou. A Mixture Model for Crowdsourcing. A preliminary version appeared at the *ICML Workshop on Data Efficient Machine Learning*, 2016.

EXPERIENCE

Summer 2018 Intern, **GOOGLE AI, PRINCETON**

Google AI,
Princeton

Designed an efficient full-matrix adaptive regularization algorithm for optimizing deep neural networks. Using an efficient low-rank matrix inversion subroutine, the optimizer outperforms popular algorithms like ADAM in language-based tasks by harnessing higher-order correlations. Released an open-source implementation in Tensorflow & PyTorch.
Host: Prof. Yoram SINGER

Summer 2014 Intern, **MICROSOFT RESEARCH, REDMOND**

Microsoft Research
Redmond

Developed a Programming-by-Natural-Language framework to synthesize programs in targeted domain-specific languages given intents expressed as natural language prompts. The system supported multiple rounds of end-user interactions making it more robust than traditional NLP approaches. Concrete instantiations of the framework offer an interactive experience for repetitive data manipulation and summarization tasks.
Host: Dr. Sumit GULWANI

AWARDS AND DISTINCTIONS

Awards for
Exceptional
Academic
Performance

- ▶ **Ranked 1st** in the department (among 96 students) and the institute (**among 820 students**) at the Indian Institute of Technology, Kanpur.
- ▶ Awarded the **President's Gold Medal** for the best academic performance in the graduating class in all disciplines.
- ▶ Awarded the **General Proficiency Medal** for the best academic performance in the discipline of Computer Science.
- ▶ Awarded the **Academic Excellence Award** for 3 years and the grade A* for **exceptional performance** in 14 courses.

Science Olympiads
and Scholarships

- ▶ Awarded the **Gold Medal** for being in the **top 35 (0.1%)** students in Indian National Physics Olympiad 2011.
- ▶ Secured **All India Rank 14** in All India Engineering Entrance Examination 2011 **among 1,050,000 students**.
- ▶ Secured **All India Rank 140** in Indian Institute of Technology Joint Entrance Examination 2011 **among 485,000 students**.
- ▶ Awarded KVPY Fellowship (2009), the most prestigious scholarship in the discipline of science offered by Government of India at high school level.
- ▶ Awarded National Talent Search (NTS) Scholarship in 2007.

TEACHING EXPERIENCE

Princeton
University

- ▶ Teaching Assistant, Introduction to Machine Learning (COS 324).
- ▶ Teaching Assistant, Artificial Intelligence and Machine Learning (COS 402).

IIT Kanpur

- ▶ Teaching Assistant for the Data Structures and Algorithms course as one of the few undergraduate students selected.

November 17, 2021