

# KARAN SINGH

## CONTACT INFORMATION

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## EDUCATION

### PRINCETON UNIVERSITY

November 2021

PhD in Computer Science.

GPA: 4.0/4

ADVISER: Elad Hazan

DISSERTATION: The Nonstochastic Control Problem

Awarded the Jacobus Fellowship, Princeton University's top graduate student honor.

### INDIAN INSTITUTE OF TECHNOLOGY, KANPUR

June 2015

Bachelor of Technology in Computer Science.

GPA: 10.0/10

Received the *President's Gold Medal*, for the best academic performance in the outgoing class.

## PROFESSIONAL AFFILIATIONS

### MICROSOFT RESEARCH, REDMOND

April 2021 –

Postdoctoral Researcher, Reinforcement Learning Group

Manager: Sham M. Kakade

### GOOGLE AI, PRINCETON

2018-2020

Student Researcher

Host: Yoram Singer

## FIELDS OF INTEREST

Provably efficient algorithms and fundamental limits for *feedback-driven* learning, spanning both *prediction* and *control*. Drawing from the algorithmic toolkits of *optimization* and *online learning*, together with techniques from *dynamical systems* and *control theory*, recent results have lead to the first instance-optimal control algorithm, and provably efficient learning in dynamical systems that exhibit long-term correlations.

## SELECTED AWARDS, HONORS & ACHIEVEMENTS

2020	IBM Herman Goldstine Postdoctoral Fellowship in Mathematical Sciences (declined)
2019	Jacobus Fellowship, Princeton University's top graduate student honor ( <a href="#">press</a> , <a href="#">more</a> )
2019	Best Paper Award, Optimization for RL workshop at NeurIPS 2019
2019	Best Reviewer (top 5%), NeurIPS 2019
2018-19	Selected twice for an Oral Presentation at NeurIPS – top 0.5% of the submissions
2018	SEAS Award for Excellence by the Graduate School at Princeton
2018	Spotlight Prize, New York Academy of Sciences' 12 <sup>th</sup> Annual ML Symposium
2015	President's Gold Medal for the best academic performance at IIT Kanpur ( <a href="#">press</a> )
	Ranked 1st (among 820 students) at IIT Kanpur
2012-2015	Academic Excellence Award for 3 years at IIT Kanpur
2011	All-India Rank 14 in AIEEE 2011 among 1,050,000 students
2011	All-India Rank 140 in IIT-JEE 2011 among 485,000 students
2011	Gold Medal, the top 35 (0.1%) students at Indian National Physics Olympiad 2011
2009	Kishore Vaigyanik Protsahan Yojana Fellowship, Government of India

## PEER-REVIEWED PUBLICATIONS

All publications list authors in the alphabetical order, except those indicated with †.

### Boosting for Online Convex Optimization

Elad Hazan, Karan Singh

*International Conference on Machine Learning (ICML), 2021*

### A Regret Minimization Approach to Iterative Learning Control

Naman Agarwal, Elad Hazan, Anirudha Majumdar, Karan Singh

*International Conference on Machine Learning (ICML), 2021*

### Improper Learning for Nonstochastic Control†

Max Simchowitz, Karan Singh, Elad Hazan

*Conference on Learning Theory (COLT), 2020*

### No-Regret Prediction in Marginally Stable Systems

Udaya Ghai, Holden Lee, Karan Singh, Cyril Zhang, Yi Zhang

*Conference on Learning Theory (COLT), 2020*

### The Nonstochastic Control Problem

Elad Hazan, Sham Kakade, Karan Singh

*Algorithmic Learning Theory (ALT), 2020*

### Logarithmic Regret for Online Control

Naman Agarwal, Elad Hazan, Karan Singh

*Neural Information Processing Systems (NeurIPS), 2019, Oral Presentation* (<0.5% of submissions)

(Also, **Best Paper Award** at the OptRL workshop at NeurIPS 2019)

### Online Control with Adversarial Disturbances

Naman Agarwal, Brian Bullins, Elad Hazan, Sham Kakade, Karan Singh

*International Conference on Machine Learning (ICML), 2019*

### Provably Efficient Maximum Entropy Exploration

Elad Hazan, Sham Kakade, Karan Singh, Abby Van Soest

*International Conference on Machine Learning (ICML), 2019*

### Efficient Full-Matrix Adaptive Regularization

Naman Agarwal, Brian Bullins, Xinyi Chen, Elad Hazan, Karan Singh, Cyril Zhang, Yi Zhang

*International Conference on Machine Learning (ICML), 2019*

### Spectral Filtering for General Linear Dynamical Systems

Elad Hazan, Holden Lee, Karan Singh, Cyril Zhang, Yi Zhang

*Neural Information Processing Systems (NeurIPS), 2018, Oral Presentation* (<0.5% of submissions)

### Learning Linear Dynamical Systems via Spectral Filtering

Elad Hazan, Karan Singh, Cyril Zhang

*Neural Information Processing Systems (NeurIPS), 2017, Spotlight* (<5% of submissions)

(Also, **Spotlight Prize** at New York Academy of Sciences' ML Symposium 2018)

### The Price of Differential Privacy for Online Learning

Naman Agarwal, Karan Singh

*International Conference on Machine Learning (ICML), 2017*

### Efficient Regret Minimization in Non-Convex Games

Elad Hazan, Karan Singh, Cyril Zhang

*International Conference on Machine Learning (ICML), 2017*

## PREPRINTS, PATENTS AND TECHNICAL REPORTS

All publications list authors in the alphabetical order, except those indicated with †.

### A Boosting Approach to Reinforcement Learning

Nataly Brukhim, Elad Hazan, Karan Singh

Preliminary version at ICML Workshop on RL Theory, 2021

### Dynamic Learning System

Elad Hazan, Karan Singh, Cyril Zhang

US Patent 11,138,513 B2, approved Oct 2021

### Machine Learning for Mechanical Ventilation Control†

Daniel Suo, Cyril Zhang, Paula Gradu, Udaya Ghai, Xinyi Chen, Edgar Minasyan, Naman Agarwal, Karan Singh, Julianne LaChance, Tom Zajdel, Manuel Schottdorf, Daniel Cohen, Elad Hazan

Machine Learning for Health (ML4H), 2021 Workshop Track

**Featured** in Princeton Engineering news

### Deluca – A Differentiable Control Library: Environments, Methods, and Benchmarking†

Paula Gradu, John Hallman, Daniel Suo, Alex Yu, Naman Agarwal, Udaya Ghai, Karan Singh, Cyril Zhang, Anirudha Majumdar, Elad Hazan

NeurIPS Workshop on Differentiable Computer Vision & Physics, 2020 Oral Presentation

### Towards Provable Control for Unknown Linear Dynamical Systems

Sanjeev Arora, Elad Hazan, Holden Lee, Karan Singh, Cyril Zhang, Yi Zhang

International Conference on Learning Representations (ICLR), Workshop Track, 2018

### Dynamic Task Allocation for Crowdsourcing†

Angela Zhou, Irineo Cabrereros, Karan Singh

ICML Workshop on Data Efficient Machine Learning, 2016

## INTERNSHIPS

**MICROSOFT RESEARCH, REDMOND**

Undergrad Research Intern

*Summer 2014*

Host: Sumit Gulwani

## TEACHING

**ECONOMICS AND COMPUTATION (COS 445)**

Princeton University

*Fall 2017*

Assistant Instructor

**ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING (COS 402)**

Princeton University

*Spring 2016*

Assistant Instructor

**INTRODUCTION TO MACHINE LEARNING (COS 324)**

Princeton University

*Fall 2016*

Assistant Instructor

**DATA STRUCTURE & ALGORITHMS (ESO 207)**

IIT Kanpur

*Fall 2014*

Teaching Assistant

**SERVICE****PROGRAM COMMITTEE**

Conference on Learning Theory (COLT) 2021, 2022

Algorithmic Learning Theory (ALT) 2021, 2022

AAAI Conference on Artificial Intelligence (AAAI), 2020

**REVIEWER**

Conference on Learning Theory (COLT) 2017, 2018, 2020

International Conference on Machine Learning (ICML) 2018, 2019, 2020, 2021

Neural Information Processing Systems (NeurIPS) 2018, 2019, 2020, 2021

International Conference on Learning Representations (ICLR) 2020, 2021

Journal of Machine Learning Research

Mathematical Programming

OptRL Workshop, NeurIPS 2019

**GRADUATE STUDENTS ADMISSIONS COMMITTEE***2018-2020*

Computer Science, Princeton University

**ORGANIZER***2017-2019*

Alg-ML Reading Group, Princeton University

**WEBMASTER***2017-2019*

ML Theory Website, Princeton University

November 19, 2021