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Computer Science Department

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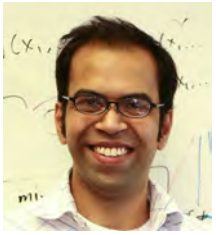
Nina Balcan

Guy Blelloch

Keenan Crane

Philip Gibbons

Aayush Jain



Anupam Gupta

Mor Harchol-Balter

Pravesh Kothari

Ryan O'Donnell

Richard Peng

Pradeep Ravikumar

Tuomas Sandholm

Nihar Shah

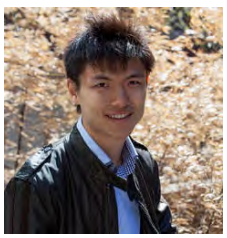
Elaine Shi

Danny Sleator

Rashmi Vinayak

Weina Wang

David Woodruff



Steven Wu

Eric Xing

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Nina Balcan, Associate Professor (CS & MLD)
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machine learning and theoretical computer science

Within machine learning, a major goal of my research is to develop foundations and algorithms for important modern learning paradigms, including interactive learning, distributed learning, multi-task, and never-ending learning. At the intersection between machine learning and game theory, I am interested in developing tools for analyzing the overall behavior of complex systems in which multiple agents with limited information are selfishly adapting their behavior over time based on past experience. Within algorithms and optimization, I am interested in identifying models of computation beyond worst-case analysis, that accurately model real-world instances and could provide a useful alternative to traditional worst-case models in a broad range of optimization problems (including learning problems of extracting hidden information from data).

Guy Blelloch, Professor (CS)
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Parallelism, Data Structures and Algorithms, Cache Efficient Parallel Algorithms

My research has largely been in the interaction of Algorithms and Programming Languages, much of it in the area of parallel computing.

Keenan Crane, Assistant Professor (CSD, RI)
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I am an Assistant Professor at Carnegie Mellon University, in the Computer Science Department and Robotics Institute. My research draws on insights from differential geometry and computer science to develop fundamental algorithms for working with real-world geometric data. I received my bachelor's degree from UIUC and was a Google PhD Fellow at the California Institute of Technology. My most recent work was supported by a NSF Mathematical Sciences Postdoctoral Fellowship at Columbia University. I advise four terrific students: Nick Sharp, Chris Yu Katherine Ye, and Rohan Sawhney. This spring I am teaching a course on Discrete Differential Geometry (15-869J at CMU).

Phillip Gibbons, Professor (CS & ECE)
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Massive data sets, parallel computation, bridging theory and systems.

In my research I work on write-efficient algorithm design, for settings (such as emerging non-volatile memories) where writes are significantly more costly than reads. I also work with mapping out and exploring the space of large-scale machine learning from a systems' perspective.

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Approximation algorithms, metric embeddings, network algorithms.

My research interests are in Theoretical Computer Science, with an emphasis on Approximation Algorithms and Metric Embeddings.

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Stochastic modeling and analysis of computer systems; Resource allocation algorithms; Scheduling algorithms

I design new scheduling/resource allocation policies for many distributed computer systems, including multi-tiered data centers, web server farms, databases, and networks. My work involves analytical modeling of systems. I use queueing theory, probabilistic analysis, stochastic processes, optimization, and lots of math in general. I am always looking for students with exceptional analytical skills and math creativity.

Pravesh Kothari, Assistant Professor (CS)
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Approximation Algorithms/Hardness, Sum-of-Squares Semi-definite Programs, Theoretical Machine Learning

My current research has mostly been about understanding the power of general-purpose convex relaxations such as sum-of-squares semidefinite programs for algorithm design. Surprisingly, this single technique happens to be extremely powerful especially for problems with ``random'' instances that naturally arise in average-case complexity (e..g finding large cliques in random graphs), theoretical machine learning (e.g. separating mixtures of gaussians), cryptography (e.g. attacking security of pseudorandom generators). On the flip side, understanding when such techniques fail can provide us with evidence of hardness or concrete directions for algorithmic progress. This investigation naturally connects to understanding properties of random graphs, phase transitions in statistical physics, Unique Games Conjecture and problems in metric geometry.

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Analysis of Boolean functions, Approximability of optimization problems, Quantum computation and information theory, Probability, Complexity theory, Property testing, and Learning theory

I study Boolean functions are perhaps the most basic object of study in theoretical computer science, and Fourier analysis has become an indispensable tool in the field. The topic has also played a key role in several other areas of mathematics, from combinatorics, random graph theory, and statistical physics, to Gaussian geometry, metric/Banach spaces, and social choice theory.

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Pradeep Ravikumar, Professor (MLD)
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mathematical and statistical foundations of machine learning

My research is on the foundations of statistical machine learning, with recent focus on representation learning, and neuro-symbolic AI. The goal is to go beyond present-day neural systems towards next-generation statistical machine learning systems that simultaneously satisfy a broad range of "reliable AI" desiderata (explainable, robust to train-time & test-time corruptions, resilient to distribution shifts)

Tuomas Sandholm, Professor (CS)
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Mechanism Design, Game Theory, Auctions.

My research is on market design; optimization (search and integer programming, combinatorial optimization, stochastic optimization, and convex optimization); game theory; mechanism design; electronic commerce; artificial intelligence; multiagent systems; auctions and exchanges; automated negotiation and contracting; equilibrium finding; algorithms for solving games; advertising markets; computational advertising; kidney exchange; prediction markets; (automated) market making; voting; coalition formation; safe exchange; preference elicitation; normative models of bounded rationality; resource-bounded reasoning; privacy; multiagent learning; machine learning; networks.

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Learning theory, statistics, game theory, information theory.

My research spans the areas of machine learning, statistics, game theory, and information theory. I specifically focus on learning from people, addressing questions such as "How to make sense of noisy and/or subjective data given by people?" and "How to obtain better data through incentives and interfaces?"

Elaine Shi Associate Professor (CS & ECE)
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Cryptography, algorithms

I am broadly interested in cryptography, algorithms, game theory, and the mathematical foundations of blockchains.

Danny Sleator, Professor (CS)
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Data structures, algorithms, parsing.

I have worked in data structures, graph algorithms, natural language parsing, automated music analysis, and mathematical games.

Rashmi Vinayak, Assistant Professor (CS)
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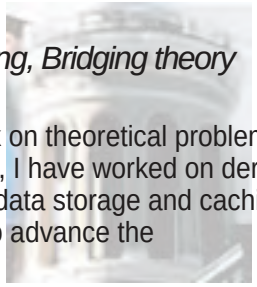
Coding theory, Algorithms for distributed data storage and caching, Bridging theory and systems.



My research interests lie at the intersection of theory and systems. On the theory side, I work on theoretical problems motivated from real-world challenges in computer and networked systems. In the recent past, I have worked on deriving fundamental limits and designing new coding-theoretic algorithms for large-scale distributed data storage and caching. On the systems side, I work on building systems that employ theoretical ideas and insights to advance the state-of-the art.
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stochastic theory, theory and algorithms for large-scale systems, data privacy

My research lies in the broad area of applied probability and stochastic systems, with applications in data centers, cloud computing, and privacy-preserving data analytics. Such applications are the backbone of many ever-developing technologies, especially the emerging big-data technology. Enormous challenges are presented by these new technologies, including scalability to large sizes, coordination of data and computation, ultra-low latency, economic efficiency, etc. The goal of my research is to provide a clear understanding of fundamental limits of systems, and build theoretical foundations for designing new architectures and algorithms.

David Woodruff, Associate Professor (CS)
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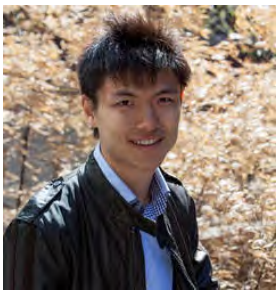
Algorithms and Complexity, Machine Learning

My current research interests are communication complexity, data stream algorithms and lower bounds, graph algorithms, machine learning, numerical linear algebra, sketching, and sparse recovery.



Steven Wu, Assistant Professor (CS, S3D, MLD, HCII)
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Machine Learning, Privacy Algorithmic Fairness, Game Theory

My work builds theoretical foundations for responsible machine learning (ML) and studies both (1) the societal impacts of ML as well as (2) the impacts of social and economic forces on the performances of ML. In studying the societal impacts of ML, I am interested in making ML better aligned with important societal values, especially privacy and fairness. For example, my work on data privacy provides a broad set of tools for privacy-preserving data analyses subject to the rigorous criterion of differential privacy. In studying the impacts of social and economic forces on ML, my work develops methods and models to understand how to ensure ML methods work reliably within social and economic dynamics. A particular focus is to study the effects of strategic manipulations on ML algorithms when they interact with agents who have incentives to manipulate their data and influence automated decisions.

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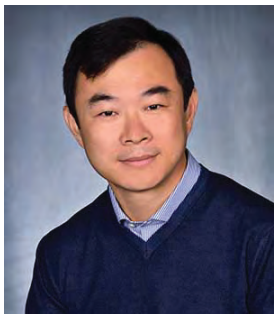

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Machine learning, high-dimensional inference, sparse coding, evolving graphs, convex optimization.

My principal research interests lie in the development of machine learning and statistical methodology, and large-scale computational system and architecture, for solving problems involving automated learning, reasoning, and decision-making in high-dimensional, multimodal, and dynamic possible worlds in artificial, biological, and social systems.