SPEAKER RESEARCH BIOS

Gill Bejerano

Assistant Professor
Development Biology and Computer Science
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Of the 3 billion bases in the human genome, only 2-3% is used to encode the genome's 20,000-25,000 protein coding genes. Recent genomics advances have revealed a multitude of cis-regulatory regions that occupy at least 3-5 times more of the genome. These roughly 1,000,000 promoters, enhancers, silencers and insulators regulate gene expression in every cell in the human body, allowing different cells to express very different protein repertoires. We study this fascinating "control layer" of the human genome, with an aim to:

1) Identify cis-regulatory elements in the human genome and annotate them for function

2) Map the cis-regulatory architecture controlling early limb, forebrain and placenta development and understand its contribution to human disease

3) Study the origins and evolution of regulatory genomic regions and reveal their contribution to vertebrate, mammalian and human specific evolution

To address these challenges we use a potent combination of computation and tools to discover cis-regulatory codes and trace their evolution; we run our tools on massive genomic datasets to generate testable hypotheses; and we perform molecular biology experiments to validate our hypotheses and generate novel ones. We work in small teams of experimentalists and computational tool users, who interact directly with our computational tool builders.

Todd Coleman

Associate Professor Bioengineering
Assistant Director for Diversity, CSoI
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His research interest includes:

- neuroscience
- information theory
- machine learning
- bio-electronics

Professor Coleman's research is multi-disciplinary at its core. His main goal is to use tools from information theory, neuroscience, machine learning and bioelectronics to understand - and control - interacting systems with biological and computer parts. His research in developing multi-functional, flexible bio-electronics are enabling wireless health applications that are minimally observable to the user. His brain-machine interface research uses information theory, control theory and neuroscience to interpret - and design - systems from the viewpoint of multiple agents cooperating to achieve a common goal. The benefits of this research include helping subjects with disabilities as well as enabling all members of society to enhance capabilities in many daily activities. His research on causal inference uses information theory and machine learning to understand causal relationships in time series of data. Within the context of neuroscience, it is being used to understand dynamical aspects of brain function. The approach is applicable to arbitrary modalities and to a variety of applications, including financial networks, social networks and network security.

Andrea Goldsmith

Professor, Electrical Engineering
Stanford University
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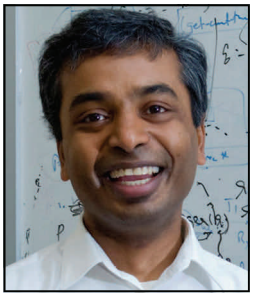
Dr. Goldsmith's research is focused on the design, analysis, and fundamental performance limits of wireless systems and networks. Wireless technology has enormous potential to change the way people and things communicate. Future wireless networks will allow people on the move to communicate with anyone, anywhere, and at any time using a range of multimedia services. Wireless communications will also enable a new class of intelligent home electronics that can interact with each other and with the Internet. Wireless video will support applications such as distance learning and remote medicine, and self-configuring wireless networks will provide the baseline technology for widespread sensor networks and automated highways. There are many technical challenges that must be overcome in order to make this vision a reality. These challenges transcend all levels of the overall system design, including hardware, communication link, network, and application design. In addition, synergies between the design of these different system layers must be exploited to meet the demanding performance requirements of future wireless systems. Professor Goldsmith and her research group are investigating many of these areas. The interdisciplinary research combines work in wireless channel modeling, information and communication theory, multiuser communications, signal processing, and wireless network design.



Ananth Grama

Professor, Computer Science
Associate Director, Knowledge Transfer Director, CSoI
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Professor Grama's research interests span the areas of parallel and distributed computing architectures, algorithms, and applications. His work on distributed infrastructure deals with development of software support for dynamic clustered and multi-clustered environments. More recent work has focused on resource location and allocation mechanisms in peer-to-peer networks. His research on applications has focused on particle dynamics methods, their applications to dense linear system solvers, and fast algorithms for data compression and analysis.

Olgica Milenkovic

Associate Professor
Electrical and Computer Engineering
University of Illinois
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The current research focus of our group is on: 1) Developing new approaches for studying problems in bioinformatics and bioengineering using coding and information theory. In particular, we investigate fundamental questions pertaining to design methodologies for DNA microarrays with error- and quality-control features and DNA microarrays that utilize compressed sensing principles. 2) Providing a bridge between the theory of compressed sensing and superimposed coding; non-linear compressive sensing with quantization and fault-tolerant sensing algorithms. 3) Using coding and information theory to study problems such as RNA folding, reverse engineering of gene-regulatory networks, and cost-constrained genome reversal distances. 4) Constructing and analyzing codes on graphs and developing new methods for studying the combinatorial properties of random ensembles of low-density parity-check codes. Our studies mainly focus on the computational complexity of problems quantifying the error-floor phenomena. 5) Analyzing the connections between network coding, matroid theory, and algebraic coding theory. 6) Analyzing the average case complexity of algorithms in coding theory and computer algebra.

Peter Shor

Morss Professor, Applied Mathematics
MIT
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Professor Shor's research interests are in theoretical computer science: currently on algorithms, quantum computing, computational geometry and combinatorics.

Madhu Sudan

Fujitsu Professor
Electrical Engineering and Computer Science
MIT
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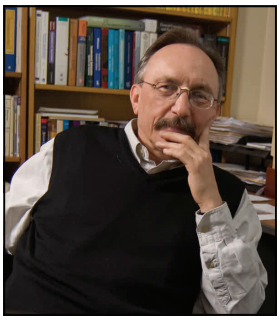
Research Interests

- Approximability of optimization problems
- Coding theory
- Complexity theory
- Algebra in computation



Wojciech Szpankowski

Saul Rosen Professor, Computer Science
Director-CSoI
Purdue University
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Before coming to Purdue, Wojciech Szpankowski was Assistant Professor at the Technical University of Gdansk, and in 1984 he was Assistant Professor at the McGill University, Montreal. During 1992/1993 he was Professeur Invité at INRIA, Rocquencourt, France. His research interests cover analysis of algorithms, data compression, information theory, analytic combinatorics, random structures, networking, stability problems in distributed systems, modeling of computer systems and computer communication networks, queueing theory, and operations research. His recent work is devoted to the probabilistic analysis of algorithms on words, analytic information theory, and designing efficient multimedia data compression schemes based on approximate pattern matching. He is a recipient of the Humboldt Fellowship. He has been guest editors for special issues in IEEE Transactions on Automatic Control, Theoretical Computer Science, Random Structures & Algorithms, and Algorithmica. He edited a special issue on "Analysis of Algorithms" in Algorithmica. He serves on the editorial boards of Theoretical Computer Science, Discrete Mathematics and Theoretical Computer Science, and book series Advances in the Theory of Computation and Computational Mathematics. Currently the Director for Center for Science of Information.

David Tse

Professor
Electrical Engineering and Computer Sciences
UC, Berkeley
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Our group's current research spans several aspects of wireless communications, from the physical layer to the networking layer to architectural issues. Some recent projects:

- An Approximation Approach to Network Information Theory
- Diversity-Multiplexing Tradeoff in Space-Time Communications
- Noncoherent Multiple Antenna Communications
- Opportunistic Multiuser Communications
- Multiple Antenna Broadcast Channels
- Capacity of Mobile Ad-hoc Networks
- Capacity of Wideband Fading Channels
- Effective Interference and Effective Bandwidth of Multiuser Receivers

Sergio Verdu

Eugene Higgins Professor
Electrical Engineering
Princeton University
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My research interest include:

- The interface between information theory and estimation theory
- The information spectrum method
- Information theoretic bounds for the finite block-length regime
- Communication in the wideband regime
- Random matrices and information theory
- Information theory of compressed sensing
- Capacity of code division multiple access and other multiple-access channels
- Multiuser detection and its fundamental limits
- Timing channels and the capacity of the single-server queues
- Harnessing feedback in communication
- Data compression with error-correcting codes
- Generation of random bits from stochastic processes
- Rate-distortion function of Poisson processes and other continuous-time Markov processes
- The maximum randomness required to simulate the input to a random system
- General formulas for minimum compression rate, channel capacity, and rate-distortion
- Discrete denoising
- Joint source-channel coding and the validity of the separation principle
- The empirical distribution of capacity-achieving codes
- Universal compression and universal estimation of information measures
- Compression and transmission

Tsachy Weissman

Associate Professor
Electrical Engineering
Stanford University
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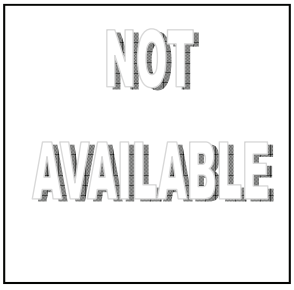
Dr. Weissman's research is focused on Information Theory, Statistical Signal Processing, the interplay between them, and their applications. He is inventor of several patents and involved in a number of high-tech companies as a researcher or member of the technical board. Among his recent awards and honors is an NSF CAREER award, a joint IT/COM societies best paper award, a Horev fellowship for Leaders in Science and Technology, and a Henry Taub prize for excellence in research.

Golan Yona

Department of Structural Biology
Stanford University

The focus areas of my group are Computational Molecular Biology and Machine Learning. We are working on large scale analysis of protein sequences and structures, exploring high-order organization within the protein space. Other research interests are mathematical and statistical models of protein families, algorithms for protein sequence and structure comparison, structural genomics, and more.



Neta Zuckerman

CITI
City of Hope, Comprehensive Cancer Center
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Computational biology: cancer, immunology.

STUDENTS

Oluwaseun Ademuwagun

Undergraduate
Computer Science
Howard University
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Predicting Marked Code-switching in African Languages. Opinion Mining (Data Mining), and Sentiment Analysis.

Himanshu Asnani

Graduate Student
Electrical Engineering
Stanford University
asnani@stanford.edu

Research Interests:
1. Information Theory; 2. Probability Theory; 3. Statistical Learning

Ashraf Bah-Rabiou

Graduate Student
Computer Sciences
University of Delaware
ashraf@udel.edu

Information retrieval and Machine Learning. As of now, I'm investigating how we can improve diversity in document rankings (i.e return more aspects of the query) in the top ranked documents, and how we can use Learning to Rank methods to improve traditional rankings as well as diversity rankings.

Ishita Basu

Graduate Student
Electrical Engineering
University of Chicago
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"Biomedical (neuronal recordings, surface EMG) signal processing/modeling for design of a tremor-prediction algorithm."

Yuxin Chen

Graduate Student
Electrical Engineering
Stanford University
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Yuxin is a graduate student in the Department of Electrical Engineering and the Department of Statistics at Stanford University. His degrees include a B.E. in Microelectronics with High Dinstinction from Tsinghua University in 2008, and an M.S. in Electrical and Computer Engineering from the University of Texas at Austin in 2010. He is currently supervised by Prof. Andrea Goldsmith and Prof. Yonina Eldar.

Yuxin's research interests are Network Algorithms, High-dimensional Estimation, Wireless Networks and Communications, Sampling Theory, Statistical Learning, Graphical Model, Convex Analysis and Optimization

Raeed Chowdhury

Undergraduate Student
Electrical Engineering
University of Illinois
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Using information theory and statistical signal processing in neural-machine interfaces.

Thomas Courtade

Post Doctoral (CSoI)
Electrical Engineering
UCLA
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I am primarily interested in multiuser information theory. Most recently, I've been working on distributed source coding problems where distortion is measured under logarithmic loss. This particular choice of distortion measure captures the idea of revealing (or hiding) a quantitative amount of information about a source. This is a common objective when the goal is to maximize wealth (or something that can be modeled as wealth), as an online advertiser might do when it mines a database for a concise representation of customer information.

Frank DeVilbiss

Graduate Student
Chemical Engineering
Purdue University
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I am currently investigating metabolic phenomena using information theory. I hope to validate a causality-based theory on metabolic control using information theory as a means to extract and measure data relevant to a cybernetic goal of metabolism. A cybernetic mathematical theory, based on viewing the regulation of metabolism as motivated by a survival goal, has been recently shown to successfully anticipate many metabolic phenomena. These include diverse uptake patterns of nutrients as well as a multiplicity of metabolic states at particular growth rates. Understanding what control goal is programmed into DNA is essential to effective metabolic engineering efforts and, more fundamentally, to the study of biology itself. This research is a synthesis of chemical engineering, biology and computer science.

Amin Emad

Graduate Student
Electrical and Computer Engineering
University of Illinois
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Amin is currently a PhD student at the University of Illinois at Urbana-Champaign in the electrical and computer engineering department. He received his MSc degree from the University of Alberta, Canada (2009), and his BSc degree from Sharif University of Technology, Iran (2007). During his studies Amin has received several scholarships and awards including the Alexander Graham Bell Canada Graduate Scholarship, the NSERC Post-graduate Scholarship, the Alberta Ingenuity Fund, and the iCORE Graduate Student Scholarship.

Amin's research interests include compressed sensing, matrix and tensor completion, and group testing with applications in biomedical sciences.

Farzaneh Farhangmehr

Graduate Student
Mechanical Aerospace Engineering
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Farzaneh's research focuses on information theory and its applications in biology. Her main area of interests are in information theoretic-based methods to reconstruct biological networks from micro-array data and scale up complex systems by analyzing statistical dependency of edges and removing the weakest nodes. She is currently developing a reduced model of protein-cytokine network by applying the above-mentioned methods.

Mohan Gopaladesikan

Graduate Student
Statistics
Purdue University
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Mohan has his undergrad in mechanical engineering from Indian Institute of Technology, Madras. He did his masters in operations research at Purdue University. Currently he is in his second year of PhD in the statistics department. His current research focus is in analysis of algorithms and random structures with analytic combinatorial tools. Presently he is working on a number of problems in random recursive trees.

He has been with the center from the summer of 2011. He is part of the Center's student leadership council. He has represented the Center's students at the NSF STC Director's meeting in Fall 2011.

Andrea Grigorescu Vlass

Graduate Student
Institute for Communications Engineering
Technische Universität München
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We use statistical and information theoretical methods to investigate the information content of neuronal firings in the cochlea of the human hear.

David Harris

Undergraduate
Computer Science
Howard University
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Social Choice Theory: Strategy Proofness of different voting protocols.

Farzad Hassanzadeh

Graduate Student
Electrical and Computer Engineering
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"Novel distance measures for rank aggregation:

Rank aggregation is the problem of combining multiple candidate rankings into one list that best reflects the candidates' standing as a whole. Rank aggregation has many applications, in fields as diverse as bioinformatics, coding theory and social sciences.

Mathematically, the rank aggregation problem can be formulated as finding a permutation that represents the ``centroid'' of a set of permutations - i.e., a permutation that minimizes a given average distance function from the given set of permutations. The main issue arising in such aggregation problems is to identify distance functions that are scalable, flexible and easy to compute.

We introduce a new class of cost-constrained permutation metrics for rank aggregation that can be approximated within a constant in polynomial time. The cost functions are based on average transposition distances and for costs that have a tree-metric form, the presented algorithms are exact. To prove the optimality of the distance computation procedure, we use Menger's theorem and graphical representations of permutations."

Kathryn Haymaker

Graduate Student
Mathematics
University of Nebraska-Lincoln
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I work in coding theory, specifically in the area of coding for flash memories. I am interested in algebraic and combinatorial constructions of codes for storage devices, and also in metrics on permutations.

Nicole Hoffner

Undergraduate Student
Biology
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Combining Molecular Engineering with Bio-integrated Flexible Electronics to Control Neurons with Precise Spatial and Temporal Resolution, in-vitro and in-vivo

Yu-Pin Hsu

Graduate Student
Electrical and Computer Engineering
Texas A&M University
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Algorithmic and control perspective networking.

Yu-Jay Huoh

Graduate Student
Statistics
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Performing sensitivity analysis on slow-to-evaluate stochastic functions. The methodology developed is intended to be applied on a 3-dimensional simulator of flow through fracture networks.

Shiblee Imtiaz Hasan

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University of Michigan-Ann Arbor
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User Experience & Mobile Interface Design

Amir Ingber

Post Doctoral
Electrical Engineering
Stanford University
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Information theory: Finite block length performance in channel, source and joint source-channel coding; applications of information theory to biology

Varun Jog

Graduate Student
Electrical Engineering and Computer Science
UC, Berkeley
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Inequalities in information theory, Discrete entropy power inequality, Optimal transport

Sudeep Kamath

Graduate Student
Electrical Engineering and Computer Science
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I am interested in understanding the capacity regions of networks. Recent results show that characterizing the capacity region even for wireline networks is a hard problem in many ways. I am interested in understanding the capacity region approximately.

Hyeji Kim

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Information theory, network information theory

Victoria Kostina

Graduate Students
Electrical Engineeing
Princeton University
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Information theory in the finite blocklength regime.

Abram Magner

Graduate Student
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Purdue University
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Information theory, analysis of algorithms.

Alexandros Manlakos

Graduate Student
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Stanford University
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Information Theory Wireless Communications Cognitive Radios.

Reza Mirghaderi

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Electrical Engineering
Stanford University
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My research interests include the general areas of:
· Wireless Communications
· Information Theory
· Economics of Information

Albert No

Graduate Student
Electrical Engineering
Stanford University
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Source/Channel coding on Poisson Channel.

Yair Noam

Post Doctoral
Electrical Engineering
Stanford University
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Signla processing with applications to communications and bioinformatics

Idoia Ochoa-Alvarez

Graduate Student
Electrical Engineering
Stanford University
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My area of research is Information Theory. Currently I am working on problems related to DNA, such as DNA compression.

Gowtham Ramani Kumar

Graduate Student
Electrical Engineering
Stanford University
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Co-ordination capacity Information theory and gambling Shannon theory Network information theory

Stefano Rini

Post Doctoral
Electrical and Computer Engineering
Technische Universität München

Entropy estimation in neuronal firings.

Pablo Robles Granda

Graduate Student
Computer Science
Purdue University
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My interest is in applied mathematics in general, but I am particularly interested in the use of Statistics and AI to the analysis of real world problems. One application is the analysis of networks, their properties, and how that can help to predict future states or infer unknown current properties of a network. I am interested also in the application of machine learning for computer vision and related topics. Other areas of my interest include distributed problem solving, and computer simulation and modeling.

Sheila Rosenberg

Post Doctoral
Bioengineering
University of California, San Diego
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Dr. Coleman and I have discussed the following potential research project:
Multisensory processing and integration is crucial for our ability to perceive, interpret, and respond, to sensory input and feedback cues. Deficits in multi-sensory integration have been implicated in cognitive disorders such as autism, dyslexia, and schizophrenia. Aberations in white matter connectivity, neurotransmission, and neuronal activity have been proposed as possible mechanisms contributing to multi-sensory integration deficits. While these theories are intriguing, the data supporting these hypotheses is limited. Here we propose to investigate the impact of alterations in myelination, neurotransmission, and localized neuronal activity patterns on the capacity for multi-sensory integration in a rat model system. To achieve this goal, we will utilize a unique brain-machine interface referred to as a tattoo electronics platform. This novel technology was developed by Dr. Coleman and colleagues and provides an unprecedented opportunity for localized analysis and manipulation in vivo. Utilizing this platform in combination with the rat model provides the potential for mechanistic and minimally invasive studies that could provide new insight into neuroanotomical, neurochemical and neurophysiological mechanisms underlying multi-sensory integration. These studies could offer unique insight into fundamental principles underlying neuronal processing in both normal and disrupted human cognitive function.

Goffrey Schiebinger

Graduate Student
Statistics
UC Berkeley
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Optimization over reproducing kernel hilbert spaces and applications to fmri data: system identification of the visual cortex.

Nima Soltani

Graduate Student
Electrical Engineering
Stanford University
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I look at the intersection of communications/information theory and neuroscience, trying to find connections where one can help the other. Currently I'm looking into using information theory to infer synaptic connections between two neurons given their firing patterns under certain physiological constraints such as spacing of the neurons, in order to eliminate false positives on the connections.

Ke Sun

Masters Student
School of Information
University of Michigan
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User experience, user research.

Christine Task

Graduate Student
Computer Science
Purdue University
ctask@purdue.edu

I'm interested in the application of differential privacy to graph-mining problems. Differentially private queries include noise which obfuscates the effect any single arbitrary individual can have on the query result; this protects privacy by preventing the publicly released results from containing evidence that any particular individual participated in the survey. The challenge with graph-mining queries is developing useful social network-analysis techniques whose results change by only a bounded amount when the data-set changes by an arbitrary individual (thus making it possible to add noise which covers the change). Removing a node from a graph can have a catastrophic effect on many graph queries, so this is a fun problem to consider.

Kartik Venkat

Graduate Student
Electrical Engineering
Stanford University
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I am currently working on relations between Information Theory and Estimation Theory.

Yao Zhu

Graduate Student
Computer Science
Purdue University
zhu36@purdue.edu

My research lies in approximate inference, Bayesian analysis, and their applications in data analysis for scientific discovery, like in biology, psychology, material science, and etc.