Talk information

Monday July 17

09:15-10:00 Shalev Ben-David: Advances in Query Complexity

Title: Advances in Query Complexity

Abstract:
Query complexity is a simple model of computation in which the only computational cost is the number of queries made to a blackbox. This model allows us to study the power of resources like non-determinism, randomness, or quantumness in computation without having to prove circuit lower bounds.

In this talk, I'll describe some of my work on query complexity. I will explain the cheat sheet technique for turning partial Boolean functions into total Boolean functions, effectively turning separations for "structured" problems into separations for "unstructured" problems. I will show how to apply this technique to get a power 2.5 separation between the randomized and quantum query complexity of a total Boolean function, beating the quadratic speedup of Grover search. I will also discuss the question of *when* quantum speedups are possible, including a characterization of the functions that exhibit exponential quantum speedups when restricted to a promise.

Based on joint works with Scott Aaronson and Robin Kothari.

Short bio:
Shalev is a final-year PhD student at MIT under the supervision of Scott Aaronson. His research interests include computational complexity and quantum computing.

Monday July 17

10:00-10:45 Yijun Chang: A Time Hierarchy Theorem for the LOCAL Model

Title: A Time Hierarchy Theorem for the LOCAL Model

Abstract:
The celebrated Time Hierarchy Theorem for Turing machines states, informally, that more problems can be solved given more time. The extent to which a time hierarchy-type theorem holds in the distributed LOCAL model has been open for many years. It is consistent with previous results that all natural problems in the LOCAL model can be classified according to a small constant number of complexities, such as O(1), O(log*n), O(log n), 2^O(sqrt{log n}), etc.

We establish the first time hierarchy theorem for the LOCAL model and prove that several gaps exist in the LOCAL time hierarchy.

1. We define an infinite set of simple coloring problems called Hierarchical 2½ -Coloring. A correctly colored graph can be confirmed by simply checking the neighborhood of each vertex, so this problem fits into the class of locally checkable labeling (LCL) problems. However, the complexity of the k-level Hierarchical 2½ -Coloring problem is Θ(n^{1/k}). The upper and lower bounds hold for both general graphs and trees, and for both randomized and deterministic algorithms.

2. Consider any LCL problem on bounded degree trees. We prove an automatic-speedup theorem that states that any randomized no(1)-time algorithm solving the LCL can be transformed into a deterministic O(log n)-time algorithm. Together with a previous result, this establishes that on trees, there are no natural deterministic complexities in the ranges ω(log*n)---o(logn) or ω(logn)---n^{o(1)}.

3. We expose a gap in the randomized time hierarchy on general graphs. Any randomized algorithm that solves an LCL problem in sublogarithmic time can be sped up to run in O(T_LLL) time, which is the complexity of the distributed Lovasz local lemma problem, currently known to be Ω(log log n) and O(log n).

The talk is based on the paper (joint work with Seth Pettie):
https://arxiv.org/abs/1704.06297

Monday July 17

11:00-12:00 Jin-Yi Cai : Classification Program for Counting Problems [Keynote]

Title: Classification Program for Counting Problems

Abstract:
For broad classes of counting problems that can be expressed as sum-of-product computations, recent work has achieved sweeping classification theorems for their complexity. These include spin systems, graph homomorphisms, counting constraint satisfaction problems, and holant problems. These problems appear everywhere in application areas in computer science, such as AI and machine learning. These classification theorems also give a definitive description about the full reach of the power of Valiant holographic algorithms for counting CSP.

I will give an overview of this classification program.

Short bio:
Jin-Yi Cai studied at Fudan University (class of 77). He continued his study at Temple University and at Cornell University, where he received his Ph. D. in 1986. He held faculty positions at Yale University (1986-1989), Princeton University (1989-1993), and SUNY Buffalo (1993-2000), rising from Assistant Professor to Full Professor in 1996. He is currently a Professor of Computer Science and Steenbock Professor of Mathematical Sciences at the University of Wisconsin--Madison.

He received a Presidential Young Investigator Award in 1990, an Alfred P. Sloan Fellowship in Computer Science in 1994, a John Simon Guggenheim Fellowship in 1998, and a Morningside Silver Medal of Mathematics in 2004. He also received the Humboldt Research Award for Senior U.S. Scientists. He has been elected a Fellow of ACM and AAAS.

He is an Editor of Journal of Computer and Systems Sciences (JCSS), an Editor of International Journal of Foundations of Computer Science, an Associate Editor of Journal of Complexity, an Editor of The Chicago Journal of Theoretical Computer Science, and an Area Editor for International Journal of Software and Informatics. He works in computational complexity theory. He has written and published over 100 research papers.

Monday July 17

13:30-14:15 Jiabao Lin : The Complexity of Boolean Holant Problems with Non-negative Weights

Title: The Complexity of Boolean Holant Problems with Non-negative Weights

Abstract:
Holant problem is a general framework to study the computational complexity of counting problems. We prove a complexity dichotomy theorem for Boolean Holant problems with non-negative weights. It is the first complete Holant dichotomy where constraint functions are not necessarily symmetric and no auxiliary function is assumed to be available.

Holant problems are indeed read-twice counting constraint satisfaction problems (#CSPs). Intuitively, some #CSPs that are #P-hard become tractable when restricted to read-twice instances. To capture them, we introduce the Block-rank-one condition. It turns out that the condition leads to a clear separation. If a function set F satisfies the condition, then #CSP(F) is in polynomial time. Otherwise Holant(F) is #P-hard unless (a) every function in F is a tensor product of functions of arity at most 2, or (b) F is holographically transformable to a product type by some real orthogonal matrix. In either case, Holant(F) is tractable.

Monday July 17

14:15-15:00 Erik Waingarten : Settling the query complexity of non-adaptive junta testing

Title: Settling the query complexity of non-adaptive junta testing.

Abstract:
In this talk, I will show that any non-adaptive algorithm that tests whether an unknown Boolean function f:{0,1}^n→{0,1} is a k-junta or ϵ-far from every k-junta must make Ω˜(k^(3/2)/ϵ) many queries. This result is essentially optimal given Blais's non-adaptive junta tester, which makes O˜(k^(3/2))/ϵ queries and shows that adaptivity enables polynomial savings in query complexity for junta testing. At a very high level, the proof proceeds by reducing the non-adaptive junta testing of a new class of random Boolean functions to a problem of distinguishing two binomial distributions with a specific kind of noisy query.

This is joint work with Xi Chen, Rocco Servedio, Li-Yang Tan, and Jinyu Xie.

Short bio:
I'm a second-year PhD student at Columbia University being advised by Xi Chen and Rocco Servedio. I am broadly interested in algorithms and complexity, and much of my recent work has focused on property testing, as well as algorithms for high-dimensional geometry. Before joining Columbia, I did my undergraduate studies in mathematics at MIT.

Monday July 17

15:15–16:00 Arnold Filtser : On Notions of Distortion and an Almost Minimum Spanning Tree with constant Average Distortion

Title: On Notions of Distortion and an Almost Minimum Spanning Tree with constant Average Distortion

Abstract:
Minimum Spanning Trees of weighted graphs are fundamental objects in numerous applications. In particular in distributed networks, the minimum spanning tree of the network is often used to route messages between network nodes. Unfortunately, while being most efficient in the total cost of connecting all nodes, minimum spanning trees fail miserably in the desired property of approximately preserving distances between pairs. While known lower bounds exclude the possibility of the worst case distortion of a tree being small, Abraham et al showed that there exists a spanning tree with constant average distortion. Yet, the weight of such a tree may be significantly larger than that of the MST. In this paper, we show that any weighted undirected graph admits a spanning tree whose weight is at most (1+\rho) times that of the MST, providing constant average distortion O(1/\rho).

The constant average distortion bound is implied by a stronger property of scaling distortion, i.e., improved distortion for smaller fractions of the pairs. The result is achieved by first showing the existence of a low weight spanner with small prioritized distortion, a property allowing to prioritize the nodes whose associated distortions will be improved. We show that prioritized distortion is essentially equivalent to coarse scaling distortion via a general transformation, which has further implications and may be of independent interest. In particular, we obtain an embedding for arbitrary metrics into Euclidean space with optimal prioritized distortion.

Monday July 17

16:00-16:45 Sahil Singla : Probing Algorithms for Combinatorial Optimization Under Uncertainty

Title: Probing Algorithms for Combinatorial Optimization Under Uncertainty

Abstract:
Combinatorial optimization is important because it captures many natural problems, e.g., spanning tree, bipartite matching, orienteering, set cover, network design, clustering, and submodular/subadditive optimization. Classically, these problems have been studied in the full-information setting where the entire input---an objective function and some constraints on a set of elements---is given and the goal is to select a feasible set to maximize/minimize the objective.

In this talk we try to solve these problems when the input is uncertain. In particular, we have some stochastic knowledge about the input but the exact value of an element is revealed only after we probe it. We can choose the order and the set of elements to probe; however, we do not wish to probe all the elements as either probing incurs a price or there are some probing constraints. We design optimal/approximation algorithms for many such problems and show that often adaptivity does not help much.

Bio:
Sahil Singla is a PhD student in the Computer Science Department at Carnegie Mellon University. He is advised by Anupam Gupta and Manuel Blum. Broadly, he is interested in theoretical problems related to the theme `Optimization Under Uncertainty'. More particularly, he is currently working on Combinatorial Optimization and his uncertainty models are inspired from areas such as Online & Approximation Algorithms, Stopping Theory, Stochastic Modeling, Decision Theory, and Algorithmic Game Theory. He is supported by a CMU Presidential Fellowship.

Tuesday July 18

09:00-09:45 Qian Li : On the sensitivity complexity of k-uniform hypergraph properties

Title: On the sensitivity complexity of k-uniform hypergraph properties.

Abstract:
In this talk, I will present a k-uniform hypergraph property with sensitivity complexity $O(n^{\lceil k/3\rceil})$ for any $k\geq3$, where n is the number of vertices. Moreover, we can do better when $k\equiv1 \mod 3$ with presenting a k -uniform hypergraph property with sensitivity $O(n^{\lceil k/3\rceil-1/2})$. This result disproves a conjecture of Babai, which conjectures that the sensitivity complexity of k -uniform hypergraph properties is at least $\Omega(n^{k/2})$. We also investigate the sensitivity complexity of other symmetric functions and show that for many classes of transitive Boolean functions the minimum achievable sensitivity complexity can be $O(N^{1/3})$, where N is the number of variables. Finally, we give a lower bound for sensitivity of k -uniform hypergraph properties, which implies the sensitivity conjecture of k -uniform hypergraph properties for any k.

Joint work with Xiaoming Sun.

Tuesday July 18

09:45–10:30 Marc Vinyals : Composing formulas in proof complexity

Title: Composing formulas in proof complexity

Abstract:
Using a hard instance of a problem to build even harder instances is a recurrent theme in computational complexity. In this talk we will discuss how this idea applies to proof complexity, in particular how we can start with a mildly hard formula, substitute each variable by with an appropriate function, and obtain strong lower bounds for the newly crafted formula.

Bio:
Marc Vinyals is a PhD student at KTH Royal Institute of Technology, Sweden. He previously obtained a diploma degree in mathematics from Universitat Politècnica de Catalunya. His research interests are in computational complexity, in particular communication complexity and proof complexity, and in SAT algorithms.

Tuesday July 18

10:45-11:45 Yijia Chen : Some bridges between classical and parameterized complexity [Keynote]

Title: Some bridges between classical and parameterized complexity.

Abstract:
Parameterized complexity is often considered to be orthogonal to classical complexity, with rather different goals and tools. However, it turns out that the classical complexity of certain problems is ultimately connected to their parameterized complexity. In this talk, I will explain some of those problems, including homomorphism and (induced) subgraph isomorphism, and approximation algorithms where the approximation ratio is measured in terms of the optimum. More concretely, I will walk you through how the parameterized hardness of the subgraph isomorphism for complete bipartite graphs leads to the constant inapproximability of the set cover problem without using the PCP-machinery.

Short bio:

Yijia Chen is a professor of Computer Science at Fudan University. Before joining Fudan, he was a professor of Computer Science at Shanghai Jiaotong University. He holds a PhD of Computer Science from Shanghai Jiaotong and a PhD of Mathematics from University of Freiburg. Hismain research interests include logic, complexity, and algorithmic graph theory.

Tuesday July 18

13:30–14:15 Peihan Miao : Laconic Oblivious Transfer and its Applications

Title: Laconic Oblivious Transfer and its Applications

Abstract:

We introduce a novel technique for secure computation over large inputs. Specifically, we provide a new oblivious transfer (OT) protocol with a laconic receiver. Laconic OT allows a receiver to commit to a large input D (of length M) via a short message. Subsequently, a single short message by a sender allows the receiver to learn m_{D[L]}, where the messages m_0, m_1 and the location L \in [M] are dynamically chosen by the sender. All prior constructions of OT required the receiver's outgoing message to grow with D.

Our key contribution is an instantiation of this primitive based on the Decisional Diffie-Hellman (DDH) assumption. The technical core of this construction is a novel use of somewhere statistically binding (SSB) hashing in conjunction with hash proof systems. Next, we show applications of laconic OT to non-interactive secure computation on large inputs and multi-hop homomorphic encryption for RAM programs.

Based on joint work with Chongwon Cho, Nico Döttling, Sanjam Garg, Divya Gupta, and Antigoni Polychroniadou.

Tuesday July 18

14:15-15:00 Eylon Yogev : Search Problems : A Cryptographic Perspective

Title: Search Problems: A Cryptographic Perspective

Abstract:
The class TFNP is the search analog of NP with the additional guarantee that any instance has a solution. TFNP has attracted extensive attention due to its natural syntactic subclasses that capture the computational complexity of important search problems from algorithmic game theory to combinatorial optimization. Thus, one of the main research objectives in the context of TFNP is to search for efficient algorithms for its subclasses, and at the same time proving hardness results where efficient algorithms cannot exist.

In this talk, I will cover a range of results regarding hardness of total search problems. First, we ask the following general question: What is the weakest assumption sufficient for showing hardness in TFNP? We answer this question and show that hard-on-average TFNP problems can be based on any hard-on-average language in NP.

Second, we consider CLS the (smallest) subclass of TFNP that captures all continuous search problems. We show the first hardness results for CLS: both in terms of black-box (where only oracle access to the function is given) and white-box (where the function is represented succinctly by a circuit).

Third, we consider a particular problem in TFNP named the Ramsey problem: Given a graph find a clique or independent set of a certain size, roughly logarithmic in the graph size. We show that under the assumption that collision resistant hash function exist Ramsey problem is hard.

Finally, we consider a new model of computation we call the succinct black-box, where there is a limitation on the size of the search function. In this case we show that for all TFNP problems there is an upper bound proportional to the description size of the function. On the other hand, for promise problems this is not the case.

Based on joint works with Pavel Hubáček, Ilan Komargodski and Moni Naor.

Tuesday July 18

15:15-16:00 Yingkai Li : Efficient Approximations for Online Dispersion Problem

Title: Efficient Approximations for Online Dispersion Problem

Abstract:
The dispersion problem has been widely studied in computational geometry and facility location, and is closely related to the packing problem. The goal is to locate n points (e.g., facilities or persons) in a k-dimensional polytope, so that they are far away from each other and from the boundary of the polytope. In many real-world scenarios however, the points arrive and depart at different times, and decisions must be made without knowing future events. Therefore we study, for the first time in the literature, the online dispersion problem in Euclidean space.

There are two natural objectives when time is involved: the all-time worst-case (ATWC) problem tries to maximize the minimum distance that ever appears at any time; and the cumulative distance (CD) problem tries to maximize the integral of the minimum distance throughout the whole time interval. Interestingly, the online problems are highly non-trivial even on a segment. For cumulative distance, this remains the case even when the problem is time-dependent but offline, with all the arriving and departure times given in advance.

For the online ATWC problem on a segment, we construct a deterministic polynomial-time algorithm which is (2ln2 + epsilon)-competitive, where epsilon > 0 can be arbitrarily small and the algorithm's running time is polynomial in 1/epsilon. We show this algorithm is actually optimal. For the same problem in a square, we provide a 1.591-competitive algorithm and a 1.183 lower-bound. Furthermore, for arbitrary k-dimensional polytopes with k ≥ 2, we provide a 2/(1+epsilon)-competitive algorithm and a 7/6 lower-bound. All our lower-bounds come from the structure of the online problems and hold even when computational complexity is not a concern. Interestingly, for the offline CD problem in arbitrary k-dimensional polytopes, we provide a polynomial-time black-box reduction to the online ATWC problem, and the resulting competitive ratio increases by a factor of at most 2. Our techniques also apply to online dispersion problems with different boundary conditions.

Tuesday July 18

16:00-16:45 Yong Wang : A binomial distribution model for TSP based on frequency quadrilaterals

Title: A binomial distribution model for TSP based on frequency quadrilaterals

Abstract:

We compute the sparse graphs for TSP via frequency graphs computed with frequency quadrilaterals.A binomial distribution model based on frequency quadrilaterals will be introduced.When we choose N frequency quadrilaterals containing an edge e to compute its frequency F(e),the binomial distribution model shows the frequency F(e) of the edges in the optimal Hamiltonian cycle is bigger than (3+2/(n-2))N with the maximum probability. Moreover, we prove the minimum frequency F(e) of the edge in the optimal Hamiltonian cycle tends to the maximum value 5N as n is big enough.This case for an edge e occurs with probability close to zero.This conclusion proves us a sparse graph containing the optimal solution if we use a frequency threshold close to 5N to filter the edges with small F(e).

Wednesday July 19

09:00-09:45 Alon Eden : The Competition Complexity of Auctions A Bulow-Klemperer Result for Multi-Dimensional Bidders

Title: The Competition Complexity of Auctions: A Bulow-Klemperer Result for Multi-Dimensional Bidders

Abstract:
A seminal result of Bulow and Klemperer [1989] demonstrates the power of competition for extracting revenue: when selling a single item to n bidders whose values are drawn i.i.d. from a regular distribution, the simple welfare-maximizing VCG mechanism (in this case, a second price-auction) with one additional bidder extracts at least as much revenue in expectation as the optimal mechanism. The beauty of this theorem stems from the fact that VCG is a prior-independent mechanism, where the seller possesses no information about the distribution, and yet, by recruiting one additional bidder it performs better than any prior-dependent mechanism tailored exactly to the distribution at hand (without the additional bidder).

In this work, we establish the first full Bulow-Klemperer results in multi-dimensional environments, proving that by recruiting additional bidders, the revenue of the VCG mechanism surpasses that of the optimal (possibly randomized, Bayesian incentive compatible) mechanism. For a given environment with i.i.d. bidders, we term the number of additional bidders needed to achieve this guarantee the environment's competition complexity.

Using the recent duality-based framework of Cai et al. [2016] for reasoning about optimal revenue, we show that the competition complexity of n bidders with additive valuations over m independent, regular items is at most $n + 2m - 2$ and at least $\log(m)$. We extend our results to bidders with additive valuations subject to downward-closed constraints, showing that these significantly more general valuations increase the competition complexity by at most an additive $m - 1$ factor. We further improve this bound for the special case of matroid constraints, and provide additional extensions as well.

Joint work with Michal Feldman, Ophir Friedler, Inbal Talgam-Cohen and S. Matthew Weinberg.

Wednesday July 19

09:45-10:30 Haifeng Xu : Persuasion Through the Computational Lens

Title: Persuasion Through the Computational Lens.

Abstract:
Persuasion, defined as the act of exploiting an informational advantage in order to influence the decisions of others, is ubiquitous. Indeed, persuasive communication has been estimated to account for a considerable share of all economic activities. In this talk, I will examine persuasion through a computational lens and look to design algorithms for optimal or approximately optimal persuasion.

I will start with one of the most fundamental models in this space, namely the Bayesian Persuasion model of Kamenica and Gentzkow. Here there are two players, a sender and a receiver. The receiver must take one of a number of actions with a-priori unknown payoff. The sender, on the other hand, has access to additional information regarding the payoffs of various actions for both players, and looks to persuade the receiver to take an action that is more preferable by the sender. We examine the sender's optimization problem in three of the most natural input models and pin down the computational complexity for each. I will then move to a natural generalization of the above model where one sender wishes to persuade multiple receivers in order to optimize a global objective that depends on all the receivers' actions. I will present tight algorithmic results and show how natural persuasion constraints can affect the complexity of the problem as well as the sender's utility. Finally, I will briefly mention some applications of the these models in real world.

Wednesday July 19

10:45-11:45 Constantinos Daskalakis : Expectation-Maximization, Power Iteration, and Non-convex Optimization in Learning and Statistics [Keynote]

Title: Expectation-Maximization, Power Iteration, and Non-convex Optimization in Learning and Statistics

Abstract:
The Expectation-Maximization (EM) algorithm is a widely used method for maximum likelihood estimation in models with latent variables. For estimating mixtures of Gaussians, its iteration can be viewed as a soft version of the k-means clustering algorithm. Despite its wide use and applications, there are essentially no known convergence guarantees for this method. We provide global convergence guarantees for mixtures of two Gaussians with known covariance matrices. We show that EM converges geometrically to the correct mean vectors, and provide simple, closed-form expressions for the convergence rate. As a simple illustration, we show that, in one dimension, ten steps of the EM algorithm initialized at infinity result in less than 1% error estimation of the means. The broader theme of our talk are non-convex methods in learning and statistics. We discuss an analytical approach towards establishing convergence guarantees for these methods based on a converse to Banach's fixed point theorem.
(Based on joint work with Christos Tzamos and Manolis Zampetakis.)

Bio:

Constantinos Daskalakis is the x-window consortium associate professor of computer science at MIT. He holds a diploma in electrical and computer engineering from the National Technical University of Athens, and a Ph.D. in electrical engineering and computer sciences from UC-Berkeley. His research interests lie in theoretical computer science and its interface with economics and probability. Daskalakis has been honored with the 2007 Microsoft Graduate Research Fellowship, the 2008 ACM Doctoral Dissertation Award, the Game Theory and Computer Science Prize from the Game Theory Society, the 2010 Sloan Fellowship in Computer Science, the 2011 SIAM Outstanding Paper Prize, the 2011 Ruth and Joel Spira Award for Distinguished Teaching, the 2012 Microsoft Research Faculty Fellowship, and the 2015 Research and Development Award by the Vatican Giuseppe Sciacca Foundation. He is also a recipient of Best Paper awards at the ACM Conference on Economics and Computation in 2006 and in 2013.

Wednesday July 19

13:30-14:15 Song Zuo : Non-clairvoyant dynamic mechanism design

Title: Non-clairvoyant dynamic mechanism design

Abstract:
Despite their better revenue and welfare guarantees for repeated auctions, dynamic mechanisms have not been widely adopted in practice. This is partly due to their computational and
implementation complexity, and also due to their unrealistic use of forecasting for future periods. We address the above shortcomings and present a new family of dynamic mechanisms that are computationally efficient and do not use any distribution knowledge of future periods. Our contributions are three-fold:

1. We present the first polynomial-time dynamic incentive-compatible and ex-post individually rational mechanism for multiple periods and for any number of buyers that is a constant approximation to the optimal revenue. Unlike previous mechanisms, we require no expensive pre-processing step and in each period we run a simple auction that is a combination of virtual value maximizing auctions.

2. We introduce the concept of obliviousness in dynamic mechanism design. A dynamic mechanism is oblivious if the allocation and pricing rule at each period does not depend on the type distributions in future periods. Our mechanism is oblivious and guarantees a 5-approximation compared to the optimal mechanism that knows all the distributions in advance.

3. We develop a framework for characterizing, designing, and proving lower bounds for dynamic mechanisms (oblivious or not). In addition to the aforementioned positive results, we use this characterization to show that no oblivious mechanism can produce a better-than-2 approximation to the mechanism that knows all the distributions.

Short Bio:

Song Zuo is a 4th year Ph.D. candidate at Institute for Interdisciplinary Information Sciences, Tsinghua University. Previously, he obtained his Bachelor Degree from Institute for Interdisciplinary Information Sciences, Tsinghua University in 2013. His research interests include Auction and Mechanism Design, Economics and Computation, Barter Exchange, and Game Theory.

Wednesday July 19

14:15-15:00 Mingfei Zhao : Simple Mechanisms for Subadditive Buyers via Duality

Title: Simple Mechanisms for Subadditive Buyers via Duality

Abstract:
It is well-known by now that the simple mechanisms we see in practice are rarely, if ever, optimal. Recent work has aimed to understand this through the lens of approximation and has successfully shown that while virtually never optimal, the simple mechanisms we see in practice are sometimes approximately optimal. In particular, prior to our work, these approximation results only hold for a single subadditive buyer or multiple buyers with matroid-rank valuations. Both results assume the buyers' valuations are over independent items.

Via extensions of the Cai-Devanur-Weinberg duality framework, we unify and improve all previous results, as well as generalizing the results to broader settings. In particular, we prove that the better of the two simple, deterministic and Dominant Strategy Incentive Compatible mechanisms, a sequential posted price mechanism or an anonymous sequential posted price mechanism with per bidder entry fee, achieves a constant fraction of the optimal revenue among all randomized, Bayesian Incentive Compatible mechanisms, when buyers valuations are XOS over independent items. When the buyers' valuations are subadditive over independent items, the approximation factor degrades to O(log m), where m is the number of items.

Wednesday July 19

15:15-16:00 Tao Xiao : Welfare maximization in auctions with budgets

Title: Welfare Maximization in Auctions with Budgets

Abstract:
Due to its practical relevance, budget constraints are becoming important issues that cannot be neglect when designing auctions. Mechanism design with budget constraints turns out to be a challenging goal. A number of impossibility results about budgeted setting are known in previous literature. In particular, for efficiency measure, it is a folklore result that with budget constraints, the social welfare cannot be approximated by a better factor than the number of agents by any truthful mechanism. In light of this, a new notion named liquid welfare was proposed as an alternative, which is much easier to approximate in terms of truthful mechanism.

In this talk, I will first introduce the liquid welfare maximization mechanism design framework, then present our results and techniques. The main technique used in designing these auctions is random sampling.

Wednesday July 19

16:00-16:45 Yu Cheng : Playing Anonymous Games using Simple Strategies

Title: Playing Anonymous Games using Simple Strategies

Abstract:
We investigate the computational complexity of approximate Nash equilibria in anonymous games. Our main algorithmic result is the following: For any n-player anonymous game with a bounded number of strategies and any constant delta, and O(1/n^{1-delta})-approximate Nash equilibrium can be computed in polynomial time. Complementing this positive result, we show that if an O(1/n^{1+delta})-approximate equilibrium can be computed in polynomial time, then there is a fully polynomial-time approximation scheme for this problem.

Our approach exploits the connection between Nash equilibria in anonymous games and Poisson multinomial distributions (PMDs). Specifically, we prove a new probabilistic lemma establishing the following: Two PMDs, with large variance in each direction, whose first few moments are approximately matching are close in total variation distance. Our structural result strengthens previous work by providing a smooth tradeoff between the variance bound and the number of matching moments.

This is a joint work with Ilias Diakonikolas and Alistair Stewart.

Thursday July 20

09:00-09:45 Xue Chen : Fourier-sparse interpolation without a frequency gap

Title: Fourier-sparse interpolation without a frequency gap

Abstract:
In recent years, a number of works have studied methods for computing the Fourier transform in sublinear time if the output is sparse. Most of these have focused on the discrete setting, even though in many applications the input signal is continuous and naive discretization significantly worsens the sparsity level.

We consider the problem of estimating a Fourier-sparse signal from noisy samples, where the sampling is done over some interval [0,T] and the frequencies can be "off-grid". Previous methods for this problem required the gap between frequencies to be above 1/T, the threshold required to robustly identify individual frequencies. We show the frequency gap is not necessary to estimate the signal as a whole: for arbitrary k-Fourier-sparse signals under \ell_2 bounded noise, we show how to estimate the signal with a constant factor growth of the noise. Moreover, we provide a sample-efficient linear regression with sample complexity polynomial in k and logarithmic in the bandwidth and signal-to-noise ratio. This sample-efficient linear regression generalizes to \ell_2 regression on arbitrary distributions over k-dimensional linear subspaces.

Joint work with Daniel Kane, Eric Price, and Zhao Song.

Short Bio:

Xue Chen is a PhD student at University of Texas at Austin, advised by Prof. David Zuckerman. He received his BS from Tsinghua University. He is interested in randomized algorithms and derandomization. Specific areas of interest include analysis and constructions of hash functions and pseudorandom generators, fast Fourier transform, and the use of randomness in computation.

Thursday July 20

09:45-10:30 Zhihao Tang : Online Makespan Minimization The Power of Restart

Title: Online Makespan Minimization: The Power of Restart

Abstract:
We consider the online makespan minimization problem on identical machines. Chen and Vestjens (ORL 1997) show that the largest processing time rst (LPT) algorithm is 1.5-competitive. For the special case of two machines, Noga and Seiden (TCS 2001) introduce the SLEEPY algorithm that achieves a competitive ratio of 1.382, matching the lower bound by Chen and Vestjens (ORL 1997). Furthermore, Noga and Seiden note that in many applications one can kill a job and restart it later, and they leave an open question whether algorithms with restart can obtain better competitive ratios.

We resolve this long-standing open question on the positive end. Our algorithm has a natural rule for killing a processing job: a newly-arrived job replaces the smallest processing job if 1) the new job is larger than other pending jobs, 2) the new job is much larger than the processing one, and 3) the processed portion is small relative to the size of the new job. With appropriate choice of parameters, we show that our algorithm improves the 1.5 competitive ratio for the general case, and the 1.382 competitive ratio for the two-machine case.

This is a joint work with Zhiyi Huang, Ning Kang, Xiaowei Wu and Yuhao Zhang.

Thursday July 20

10:45-11:45 Nick Gravin: Prediction with Expert advice : tight adversarial perspective [Keynote]

Title: Prediction with Expert advice: tight adversarial perspective

Abstract:
The problem of prediction with expert advice was the first framework proposed for online learning. It is a classical adversarial framework that encompasses several applications as special cases. One of the major outcomes of this study was a discovery (independent re-discovery) of multiplicative weights update algorithmic paradigm (MWA), which is extensively used in Machine learning, Game Theory, Fast LP and SDP solvers, various areas in Theoretical Computer Science. However, MWA has optimal asymptotic regret only when both number of experts k and time T go to infinity [Cesa-Bianci 97]. Despite large amount of progress on the expert problem, the only known optimal regret bound for a fixed number of experts was obtained by Cover in 1965 for k=2 experts. We design the optimal algorithm, adversary and regret for the case of 3 experts in the adversarial setting with the geometric stopping time. Moreover, our algorithms for k=2,3 experts are a probability matching algorithm (analogous to Thompson sampling) against a particular randomized adversary. On the other hand, even the existing lower bound analysis for MWA algorithm were not tight for any fixed small number of experts k=2,3,4 etc. We develop simple adversarial primitives, that lend themselves to various combinations leading to sharp lower bounds for many algorithmic families. We use these primitives to close the gap between upper and lower bounds for MWA in a more standard fixed time horizon regime.

(Based on joint work with: Yuval Peres, Balasubramanian Sivan)

Bio:

Nick Gravin is an associate professor of computer science at Shanghai University of Finance and Economics. He completed his bachelor degree in mathematics at Saint-Petersburg State University and two PhDs: first in mathematics from St.Petersburg Steklov institute of mathematics in Russia, and second in computer science from Nanyang Technological University. Nick worked a postdoctoral researcher at Microsoft research New England and MIT. His research interests are in theoretical computer science and discrete mathematics and its intersections with economics, combinatorial optimisation, convex and discrete geometry, and probability theory. Gravin has been awarded Microsoft Asia fellowship in 2011; and received 1000-national youth award from Chinese government in 2017. On a personal note, He is still interested in math and programming contest problems, after his school and college years when he attended multiple Math Olympiads and programming contests.

Thursday July 20

13:30–14:15 Fan Wei : Fast Permutation Property Testing and Metrics of Permutations

Title: Fast Permutation Property Testing and Metrics of Permutations

Abstract:
The goal of property testing is to quickly distinguish between objects which satisfy a property and objects that are epsilon-far from satisfying the property. There are now several general results in this area which show that natural properties of combinatorial objects can be tested with ``constant'' query complexity, depending only on epsilon and the property, and not on the size of the object being tested. The upper bound on the query complexity coming from the proof techniques are often enormous and impractical. It remains a major open problem if better bounds hold.

Hoppen, Kohayakawa, Moreira, and Sampaio conjectured and Klimo\v sov\'a and Kr\'al' proved that hereditary permutation properties are strongly testable, i.e., can be tested with respect to Kendall's tau distance. The query complexity bound coming from this proof is huge, even for testing a single forbidden subpermutation. We give a new proof which gives a polynomial bound in $1/\epsilon$ in this case.

Maybe surprisingly, for testing with respect to the cut metric, we prove there is a universal (not depending on the property), polynomial in 1/epsilon query complexity bound for two-sided testing hereditary properties of sufficiently large permutations. We further give a nearly linear bound with respect to a closely related metric which also depends on the smallest forbidden subpermutation for the property. Finally, we show that several different permutation metrics of interest are related to the cut metric, yielding similar results for testing withrespect to these metrics.

This is a joint work with Jacob Fox.

Thursday July 20

14:15-15:00 Yang Yuan : Convergence Analysis of Two-layer Neural Networks with ReLU Activation

Title: Convergence Analysis of Two-layer Neural Networks with ReLU Activation

Abstract:
In recent years, stochastic gradient descent (SGD) based techniques has become the standard tools for training neural networks. However, formal theoretical understanding of when and why SGD can train neural networks in practice is largely missing.

In this talk, I will talk our recent work about convergence analysis for SGD on two-layer feedforward networks with ReLU activations. I will show that, with standard O(1/\sqrt{d}) weight initialization and a "identity link", SGD converges to the global minimum in polynomial number of steps. Unlike traditional theorems, our convergence has "two phases". In phase I, a potential function g gradually decreases. Then in phase II, SGD enters a nice one point convex region and converges. I will also show that the identity link is necessary for convergence, as it moves the initial point to a better place for optimization. Experiment verifies our claims.
To the best of our knowledge, this is the first convergence result of SGD for neural network with nonlinear activations without independent activation assumption.

This is joint work with Yuanzhi Li from Princeton University.

Bio:
Yang Yuan is a fifth year CS PhD student at Cornell University, advised by Professor Robert Kleinberg. He did his undergraduate study at Peking University (2008-2012). He was a visiting student at MIT/Microsoft New England (2014-2015), and Princeton University (2016 Fall). He is interested in optimization for machine learning, deep learning, and game theory. He is particularly interested in how stochastic gradient descent algorithm works for non-convex functions.

Thursday July 20

15:15-16:00 Lingxiao Huang : Stochastic k-Center and j-Flat-Center Problems

Title: Stochastic k-Center and j-Flat-Center Problems

Abstract:
Solving geometric optimization problems over uncertain data has become increasingly important in many applications and has attracted a lot of attentions in recent years. In this paper, we study two important geometric optimization problems, the k-center problem and the j-flat-center problem, over stochastic/uncertain data points in Euclidean spaces. For the stochastic k-center problem, we would like to find k points in a fixed dimensional Euclidean space, such that the expected value of the k-center objective is minimized. For the stochastic j-flat-center problem, we seek a j-flat (i.e., a j-dimensional affine subspace) such that the expected value of the maximum distance from any point to the j-flat is minimized. We consider both problems under two popular stochastic geometric models, the existential uncertainty model, where the existence of each point may be uncertain, and the locational uncertainty model, where the location of each point may be uncertain. We provide the first PTAS (Polynomial Time Approximation Scheme) for both problems under the two models. Our results generalize the previous results for stochastic minimum enclosing ball and stochastic enclosing cylinder.

The link is https://arxiv.org/abs/1607.04989.

Thursday July 20

16:00–16:45 Jieming Mao : Identifying the top-k items with noisy comparisons

Title: Identifying the top-k items with noisy comparisons

Abstract:
Motivated by applications in recommendation systems, web search, social choice and crowdsourcing, we consider the problem of identifying the top-k items with noisy comparisons. The goal is to output the top-k items with high probability and with as few comparisons as possible. In this talk, I will talk about three different issues for this problem: (1) how the adaptiveness of the algorithm affects the number of comparisons needed (2) instance optimality for complicated noise models (3) whether multi-wise comparisons are more helpful than pair-wise comparisons.

Bio:
Jieming Mao is a fourth-year PhD student in the computer science department at Princeton University. His advisor is Mark Braverman. He is interested in understanding the power of algorithms in strategic or noisy environments. He recently has been working on projects like multi-armed bandit algorithms in strategic settings, finding top-k items with noisy comparisons and communication complexity lower bounds on combinatorial auctions.