LSE Department of Mathematics

PhD Seminar on Combinatorics, Games and Optimisation in 2018 (Lent and Summer)

Seminars are listed in reverse chronological order, most recent first

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Friday 11 May - Shagnik Das (FU Berlin)

Colourings without monochromatic chains

In 1974, Erdős and Rothschild introduced a new kind of extremal problem, asking which n-vertex graph has the maximum number of monochromatic-triangle-free red/blue edge-colourings. While this original problem strengthens Mantel's theorem, recent years have witnessed the study of the Erdős-Rothschild extension of several classic combinatorial theorems. In this talk, we seek the Erdős-Rothschild extension of Sperner's Theorem. More precisely, we search for the set families in 2^{[n]} with the most monochromatic-k-chain-free r-colourings. Time and interest permitting, we shall present some results, sketch some proofs, and offer open problems.

This is joint work with Roman Glebov, Benny Sudakov and Tuan Tran.

Friday 2 March - Adrian Vetta (McGill)

Ascending Combinatorial Auctions: Theory and Practice

I will explain the workings of ascending combinatorial auctions. In particular, I will examine the combinatorial clock auction (CCA) and its variants used in bandwidth auctions. Examples and theoretical results will be given that explain how minor modifications in the auction design can lead to dramatic improvements in the quantitive performance guarantees associated with the CCA. This talk will be based upon recent work with Max Dupre le Tour and prior work with Nicolas Bousquet, Yang Cai, and Christoph Hunkenschröder.

Friday 23 February - Cedric Koh (Waterloo)

Stabilizing Weighted Graphs

An edge-weighted graph G=(V,E) is called stable if the value of a maximum-weight matching equals the value of a maximum-weight fractional matching. Stable graphs play an important role in some interesting game theory problems, such as network bargaining games and cooperative matching games, because they characterize instances which admit stable outcomes. Motivated by this, in the last few years many researchers have investigated the algorithmic problem of turning a given graph into a

stable one, via edge- and vertex-removal operations. However, all the algorithmic results developed in the literature so far only hold for unweighted instances, i.e., assuming unit weights on the edges of G.
We give the first polynomial-time algorithm to find a minimum cardinality subset of vertices whose removal from G yields a stable graph, for any weighted graph G. The algorithm is combinatorial and exploits new structural properties of basic fractional matchings, which are of independent interest. In particular, one of the main ingredients of our result is the development of a polynomial-time algorithm to compute a basic maximum-weight fractional matching with minimum number of odd cycles in its support. This generalizes a fundamental and classical result on unweighted matchings given by Balas more than 30 years ago, which we expect to prove useful beyond this particular application.
In contrast, we show that the problem of finding a minimum cardinality subset of edges whose removal from a weighted graph G yields a stable graph, does not admit any constant-factor approximation algorithm, unless P=NP. In this setting, we develop an O(Delta)-approximation algorithm for the problem, where Delta is the maximum degree of a node in G. This is joint work with Laura Sanità.

Friday 16 February - Olaf Parczyk (Frankfurt)

Randomly perturbed graphs

We study the model of randomly perturbed dense graphs, that is, for any constant $\alpha >0$, the union of some n-vertex graph G_α with minimum degree at least αn and the binomial random graph $G(n,p)$.
We introduce a general approach for studying the appearance of spanning subgraphs in this model. Using this, we can give simpler proofs of several results in the literature concerning the appearance of different spanning subgraphs in this model and obtain new results for bounded degree graphs, powers of Hamilton cycles and universality for bounded degree trees. This addresses two questions of Krivelevich, Kwan, and Sudakov.
This is joint work with Julia Böttcher, Jie Han, Yoshiharu Kohayakawa, Richard Montgomery, and Yury Person.

Friday 2 February - George Barmpalias (Institute of Software, Chinese Academy of Sciences, Beijing)

From algorithmic learning of languages to learning probability distributions (and back).

Algorithmic learning theory traditionally studies the learnability of grammars given sufficiently long texts, while recent work by (Vitanyi and Chater 2017) and (Bienvenu et al. 2014) has adapted this framework to the study of learnability of probability distributions from random data.

In this study, one is given a sufficiently long stream of random data and the task is to guess a probability distribution with respect to which the data is algorithmically random.

We show certain equivalences between algorithmic learning of languages and probability distributions, that allow to transfer much of the classic theory to the study of algorithmic learning of probability distributions. In particular, we prove that for certain families of probability measures that are parametrized by reals (texts), learnability of a subclass of probability measures is equivalent to learnability of the class of the corresponding real parameters. Based on these equivalences, we present a number of applications, providing many new results regarding explanatory and behaviorally correct learnability of classes of measures, thus drawing parallels between the two learning theories.

Friday 12 January - Stanislav Kučera (LSE)

Simultaneous Minimum Spanning Trees

Simultaneous Embedding with Fixed Edges (SEFE) is a problem where given k planar graphs we ask whether they can be simultaneously embedded so that the embedding of each graph is planar and common edges are drawn the same. Problems of SEFE type have inspired questions of Simultaneous Geometrical Representations and further derivations. Based on this motivation we investigate the generalisation of the simultaneous paradigm on the classical combinatorial problem of minimum spanning trees. Given k graphs with weighted edges, such that they have a common intersection, are there minimum spanning trees of the respective graphs such that they agree on the intersection? We show that the unweighted case is polynomial-time solvable while the weighted case is only polynomial-time solvable for $k=2$ and it is NP-complete for $k>2$.