Two one-day

Colloquia in Combinatorics

09 and 10 May 2018

If attending both days, please keep this programme for day two

#CC2018 @QMULMaths @LSEMaths
QMUL & LSE have hosted the Colloquia in Combinatorics for the past eleven years. Thank you for joining us and supporting us through the years.

SUPPORT

Support for this event from the London Mathematical Society (www.lms.ac.uk) and the British Combinatorial Committee (www.britishcombinatorial.wordpress.com) is gratefully acknowledged.
Those interested are welcome to attend for all or any part of the event; it is hoped that many people will be able to attend for both days.

Some funds are available to contribute to the **basic** travel expenses of **UK-based research students** who attend the meetings. We ask you to keep costs to a minimum, using public transport on **all** occasions and off-peak student travel tariffs wherever possible. Receipts for all journeys must be maintained as proof of travel. At this stage, we are unable to confirm the maximum amount available. Expense claim forms are available at the event from the event organisers. Please contact Enfale Farooq (e.farooq@lse.ac.uk) for further information.

Event organisers: Julia Böttcher (LSE), David Ellis (QMUL), Jan van den Heuvel (LSE), Jozef Skokan (LSE) and Justin Ward (QMUL).
The first day of the Colloquia in Combinatorics will be held at Queen Mary, University of
London, starting at 10.30am. Everyone interested is welcome to attend any part of the event.
All the talks will be held in the Peston Lecture Theatre, Graduate Centre, Mile End Campus,
QMUL. Refreshment breaks will be taken in the Graduate Centre Foyer.

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10:30  Carsten Thomassen (Technical University of Denmark)

The weak circular flow conjecture and its consequences

Jaeger’s weak circular flow conjecture (now a theorem) says that, for each odd natural number \( k \), there exists a natural number \( f(k) \) such that every \( f(k) \)-edge-connected graph has an orientation which is balanced modulo \( k \). We discuss some recent applications to graph factors modulo \( k \), group-flow, unit-vector-flow, and the 1-2-3-conjecture.

11:20  János Pach (EPFL and Rényi Institute)

Triangles: Erdős, Tutte, and butterflies

In 1934, during his first visit to Trinity College, Cambridge, the 21 years old P. Erdős raised the following question: Is it possible to tile a unit square with finitely many smaller squares, no two of which are congruent? It has taken a few years before four promising students at Trinity College, R. L. Brooks, C. A. B. Smith, A. H. Stone, and W. T. Tutte, all of whom became prominent mathematicians, managed to answer Erdős’s question in the affirmative. I will report on some recent developments related to this question, motivated by several conjectures of R. Nandakumar. In particular, we prove that the plane cannot be tiled with pairwise noncongruent triangles of the same area and the same perimeter.

This is joint work with Andrei Kupavskii and Gábor Tardos.

13:30  Paul Russell (University of Cambridge)

Monochromatic infinite sumsets

It is well known that there is a finite colouring of the natural numbers such that there is no infinite set \( X \) with \( X + X \) (the pairwise sums from \( X \), allowing repetition) monochromatic. It is easy to extend this to the rationals. Hindman, Leader and Strauss showed that there is also such a colouring of the reals, and asked if there exists a space ‘large enough’ that for every finite colouring there does exist an infinite \( X \) with \( X + X \) monochromatic. We show that there is indeed such a space.

This is joint work with Imre Leader.
14:20 Katherine Staden (University of Oxford)

**Stability via symmetrisation**

The method of symmetrisation was employed by Zykov in 1949 to give a new proof of Turán’s theorem in graph theory. Since then it has been useful in other extremal problems. In this talk, I will discuss a sufficient condition for the stability property of extremal graph problems that can be solved via this method. Our criterion is stated in terms of the analytic limit version of the problem. We show that, for example, it applies to the inducibility problem for an arbitrary complete bipartite graph $B$, which asks for the maximum number of induced copies of $B$ in an $n$-vertex graph.

This is joint work with Hong Liu, Oleg Pikhurko and Maryam Sharifzadeh.

15:40 Agelos Georgakopoulos (University of Warwick)

**From mafia expansion to analytic functions in percolation theory**

I will present a (finite) random graph model that admits various definitions, one of which is via a percolation model on an infinite group. This will lead us to an excursion into classical results and open problems in percolation theory. The talk will be pitched at the non-expert, and with an emphasis on the usefulness of combinatorial ideas.

This is partly joint work with J. Haslegrave, and with C. Panagiotis.

16:30 Nikhil Bansal (Eindhoven University of Technology)

**An algorithmic version of Banaszczyk’s discrepancy theorem**

In the 90’s Banaszczyk developed a very powerful method for discrepancy problems, that goes beyond the partial coloring method. His result was based on deep ideas from convex geometry and was non-constructive. In this talk, I will present an alternate proof of this result, which is based on elementary techniques and also gives an efficient algorithm. This leads to the first efficient algorithms for several previous results in discrepancy.

Based on joint work with Daniel Dadush, Shashwat Garg and Shachar Lovett.
PLACES TO EAT: in and around QMUL

Close by:

90-degree Melt – Vegetarian, molten-cheese-based menu – 235 Mile End Rd
Costa – standard café – 556 Mile End Rd
Efes – Turkish: kebabs, etc. – 230 Mile End Rd
Greedy Cow – burgers, salads & steaks – 2 Grove Rd
Morgan Arms – gastropub, possibly too far for lunch – 43 Morgan St
Nandos – Portuguese-style chicken chain – 552 Mile End Rd
The Coffee Room – best coffee in the ‘hood – 6A Grove Rd
The Half Moon – Wetherspoon's, standard pub food – 213–223 Mile End Rd
The Pizza Room – pizzas – 2A Grove Rd
Verdi’s – upscale Italian (by Mile End standards) – 237 Mile End Rd

On campus:

Cafe Grad – Starbucks coffee and sandwiches – Graduate Centre
Drapers Bar & Kitchen – basic student union-run operation – Godward Square
Infusion – shop with take-away sandwiches, etc. – Godward Square
Mucci’s – pasta & pizza – Library Square
SCR Bar – freshly made sandwiches, limited hot food – Queen’s Building

Taken from Google Maps
Mile End Campus

Educational/Research

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- G.E. Fogg Building: 13
- G.O. Jones Building: 25
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Information

Visitors who require further information or assistance should please go to the main reception in the Queens’ Building.

- The smoking of cigarettes or tobacco products are only permitted at designated smoking areas / shelters indicated on this map.
- Electronic cigarettes permitted on outside spaces only.
- These premises are alarmed and monitored by CCTV; please call Security on +44 (0)20 7882 5000 for more information.

Key

- Library/bookshop
- Fitness centre
- Refreshment: Bar/Eatery/Coffee place
- Staff car park
- Bicycle parking
- Bicycle lockers
- Cash machine
- Smoking area / shelter

Building construction site
Building closed for major refurbishment

Library/Teaching Rooms

The Curve

Bedford Road

West View

Bancroft Road

London

Road

Leatherdale

Street

Rosslyn

Street

Carroll

Street

Mile

End

Hospital

Mile

End

College

Street

Mile

End

Road

Stepney

Green

Tube

Station

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THURSDAY 10 MAY 2018

Schedule

The second day of the Colloquia in Combinatorics will be held at The London School of Economics and Political Science, starting at 10.30am. Everyone interested is welcome to attend any part of the event. The talks will be held in the Sheikh Zayed Theatre, New Academic Building, LSE. Refreshment breaks will be taken in the Lower Ground Floor Atrium, New Academic Building, LSE; the reception will be held on the 8th Floor, New Academic Building, LSE.

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10:30 Perla Sousi (University of Cambridge)

**Random walk on dynamical percolation**

We study the behaviour of random walk on dynamical percolation. In this model, the edges of a graph $G$ are either open or closed and refresh their status at rate $\mu$, while at the same time a random walker moves on $G$ at rate 1, but only along edges which are open. I will talk about the mixing time of this process in the case where $G$ is the $d$-dimensional lattice and the complete graph.

Based on joint works with Y. Peres and J. Steif and with Sam Thomas.

11:20 Patrice Ossona de Mendez (CNRS, Paris)

**Sparsity and beyond**

We review some recent progress in the study of structural properties of sparse graphs and sketch recent exciting developments on “structural sparsity”, allowing to generalize tools used for sparse graphs to dense low complexity graphs.

13:30 Sofia Lindqvist (University of Oxford)

**Monochromatic solutions to** $x + y = z^2$

We show that given any 2-colouring of the natural numbers, there are infinitely many monochromatic solutions to the equation $x + y = z^2$. The proof makes use of the arithmetic regularity lemma to find a long monochromatic arithmetic progression. By assuming that we have no monochromatic solutions we can then apply an iterative argument to find longer and longer monochromatic arithmetic progressions, until we eventually reach a contradiction.

This is joint work with Ben Green.
Induced arboricity of graphs

For a graph $G$, the arboricity $a(G)$ is the smallest number of forests covering the edges of $G$. The induced arboricity $ia(G)$ is the smallest number of induced forests of $G$ covering its edges. While the arboricity is a well understood parameter depending on local densities according to Nash-Williams theorem, the induced arboricity has a different nature. For a class of graphs $F$, set

$$ia(F) = \sup\{ia(G) : G \in F\}.$$  

We characterise classes of graphs for which $ia(F)$ is finite and provide specific bounds on $ia(F)$ for some special classes of graphs, such as planar graphs. In addition, we define a generalised induced arboricity $ia_k(G)$ similarly to the induced arboricity with an additional restriction that each component in each covering forest has size at least $k$. We prove that for any class $F$ of graphs of bounded expansion and any $k$, there is a constant $b_k(F)$ such that $ia_k(G) < b_k(F)$ for any graph $G$ from $F$.

This is a joint work with Daniel Goncalves, Philip Doerr, Jonathan Rollin, and Torsten Ueckerdt.

Random colorings of bounded degree graphs

A well-known conjecture in computer science and statistical physics is that Glauber dynamics on the set of $k$-colorings of a graph $G$ on $n$ vertices with maximum degree $\Delta$ is rapidly mixing for $k \geq \Delta + 2$. In 1999 Vigoda showed rapid mixing time of a modified version of flip dynamics for $k > 11/6\Delta$, implying polynomial time mixing for Glauber dynamics under the same constraints. This conjecture has attracted a lot of attention in the literature and better results are known for certain classes of graphs.

In this talk, we improve Vigoda’s bound for general graphs by showing that there exists a constant $\eta > 0$ such that the Glauber dynamics mixes in polynomial time for $k \geq (11/6 - \eta)\Delta$. Our proof combines path coupling with a new kind of metric we introduce to incorporate a count of the extremal configurations of the chain. This "extremal" metric proves to be much easier to analyze than stopping-time-based metrics, and hence we believe will have fruitful applications for bounding the mixing times of other Markov chains.

This is joint work with Guillem Perarnau and Luke Postle.
16:30  Alexander Sidorenko (New York)

‘The Norman Biggs Lecture’: Extremal problems on the hyper-cube and the codegree Turán density of complete $r$-graphs

We study the generalized Erdős-Ginzburg-Ziv problem for finite abelian groups and use results in this area to prove new bounds for the codegree Turán density of complete $r$-graphs.
As part of the Colloquia in Combinatorics 2018, there is a poster session, allowing PhD students in Discrete Mathematics and related areas to present their work. The poster session runs from 10:00 to 17:30 and the best poster prize will be awarded during the wine reception (around 6pm). The jury for this prize is a subset of speakers of the Colloquia.

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PLACES TO EAT: in and around LSE

Close by:

All Bar One – modern chain with full menu – 58 Kingsway
Belgo – Belgian beer & food – 67 Kingsway
Bill’s – European chain with full menu – 42 Kingsway
Costa – standard café – 9-11 Kingsway
EAT – sandwich bar (chain) – 7-9 Kingsway
Paul – bakery & café – 36-38 Kingsway
Pret a Manger – standard café – 29-33 Kingsway
Sainsburys – supermarket – 129-133 Kingsway
Shakespeare’s Head – Wetherspoon’s, standard pub food – 64-78 Kingsway
Starbucks – standard café – 10 Kingsway
The Delaunay Counter – casual café-deli – 55 Aldwych
Viet Eat – Vietnamese – 48 Kingsway
Wasabi – Japanese chain serving bento boxes, sushi & hot food – 19 Kingsway

On campus:

The Bean Counter – café with hot & cold snacks – 32 Lincoln’s Inn Fields
Café 54 – grab & go – New Academic Building
Fields Bar and Kitchen – perfect for a relaxed lunch – Lincoln’s Inn Fields
Fourth Floor Café Bar – relaxing café with freshly made deli sandwiches – Old Building
Fourth Floor Restaurant – offers a wealth of eating options – Old Building
George IV Pub – perfect for a pub lunch – Portugal Street
LSE Garrick – cafe & restaurant – Columbia House
Mezzanine Café – pop up with different daily options – New Academic Building
Plaza Café – coffee and snacks – John Watkins Plaza
Get the discussion going: when tweeting about the Colloquia, please use the hashtag #CC2018

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