

2016 Colloquia in Combinatorics

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[Two consecutive one-day events hosted by QMUL and LSE - tenth anniversary](#)

Two consecutive one-day events hosted by QMUL and LSE - tenth anniversary

Wednesday 11th May 2016

Thursday 12th May 2016



Karim Adiprasito (Hebrew University of Jerusalem, Jerusalem, Israel)
The Hodge-Riemann Relations in Combinatorics

Béla Bollobás (University of Cambridge, Cambridge, UK and University of Memphis, Memphis, USA)
Problems and Results on Random Geometric Graphs

David Conlon (University of Oxford, Oxford, UK)
Finite Reflection Groups and Graph Norms

Andrew Granville (Université de Montréal, Montréal, Canada and UCL, London, UK)
Smoothing Sieve Weights

Imre Leader (University of Cambridge, Cambridge, UK)
Transitive Misère Games

Yufei Zhao (University of Oxford, Oxford, UK)
Quasirandom Cayley Graphs

Venue: [Fogg Lecture Theatre, G.E. Fogg Building, QMUL](#) (please note this is a change to last year's venue)

Contacts: [Robert Johnson](#) (r.johnson@qmul.ac.uk) and [David Ellis](#) (d.ellis@qmul.ac.uk)

Wednesday 11th May 2016

Thursday 12th May 2016



THE LONDON SCHOOL
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POLITICAL SCIENCE ■

BIGGS LECTURE: **Alan Frieze** (Carnegie Mellon University, Pittsburgh, USA)
Purchasing Under Uncertainty

Daniela Kühn (University of Birmingham, Birmingham, UK)
Packing Bounded Degree Graphs (presentation available [here](#))

Monique Laurent (Centrum Wiskunde & Informatica, Amsterdam, Netherlands and Tilburg University, Tilburg, Netherlands)
Geometric Graph Realizations and Positive Semidefinite Matrix Completion (presentation available [here](#))

Nati Linial (Hebrew University of Jerusalem, Jerusalem, Israel)
High-dimensional Permutations and Discrepancy (presentation available [here](#))

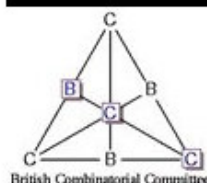
James Maynard (University of Oxford, Oxford, UK)
Primes with Missing Digits

Benny Sudakov (ETH Zürich, Zürich, Switzerland)
Equiangular Lines and Spherical Codes in Euclidean Spaces

Venue: [Wolfson Theatre, New Academic Building, LSE](#) (please note this is a change to last year's venue)

Contact: [Julia Böttcher](#) (j.boettcher@lse.ac.uk) and [Jozef Skokan](#) (j.skokan@lse.ac.uk)

Supported by

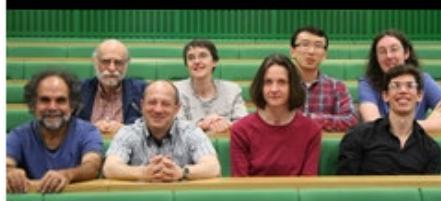


LONDON
MATHEMATICAL
SOCIETY

Event Programme



Report on CC2016



2016 sees the **tenth year** of the Colloquia in Combinatorics and we are excited to celebrate this milestone by making this Colloquia our biggest and best yet.

To view the full event programme, including schedule, please click [here](#). You can download this PDF file, for ease of use.

Those interested are welcome to attend for all or any part of the event. The two hosting institutions are less than half an hour apart by tube; it is hoped that many people will be able to attend for both days. There is no formal registration process and seats will be allocated each day on a first come, first served basis.

Queries should be sent to [Rebecca Lumb](#).

Funding

Some funds are available to contribute to the **basic** travel expenses of UK-based research students who wish to attend the meetings. We would 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; please contact [Rebecca Lumb](#) for further information.

There are also some funds available from the London Mathematical Society for help with childcare costs. Further details can be found at <http://www.lms.ac.uk/content/childcare-supplementary-grants>.

Event Support

Support for this event by the [London Mathematical Society](#) and the [British Combinatorial Committee](#) is gratefully acknowledged by the organisers.

Event Poster

A poster advertising both days of the event is available to download [here](#). Please do feel free to electronically distribute this to anyone who might be interested, append to local websites (linking back to this site using the URL <http://tiny.cc/Colloquia>) or print out to share on public notice boards.

Combinatorics

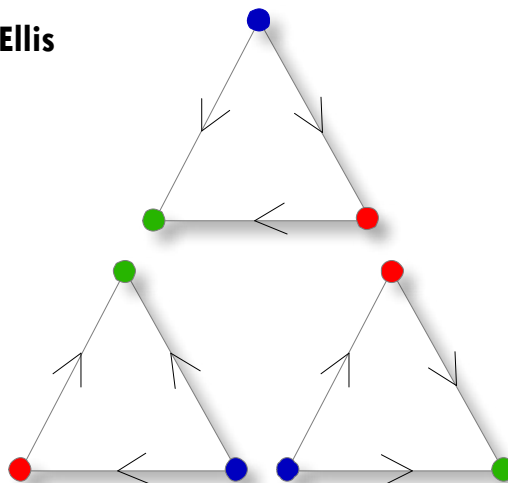
Wednesday 11 May 2016

Queen Mary, University of London

Fogg Lecture Theatre, G.E. Fogg Building

Organisers: Robert Johnson and David Ellis

- **Karim Adiprasito** (Jerusalem)
- **Béla Bollobás** (Cambridge)
- **David Conlon** (Oxford)
- **Andrew Granville** (Montréal/UCL)
- **Imre Leader** (Cambridge)
- **Yufei Zhao** (Oxford)



Thursday 12 May 2016

London School of Economics

Wolfson Theatre, New Academic Building

Organisers: Julia Böttcher and Jozef Skokan

- **Alan Frieze** (Pittsburgh)
- **Daniela Kühn** (Birmingham)
- **Monique Laurent** (Amsterdam)
- **Nati Linial** (Jerusalem)
- **James Maynard** (Oxford)
- **Benny Sudakov** (Zürich)

The programmes at both Queen Mary and LSE will start at 10.30am, with coffee from 10.00am

2016 sees the **tenth year** of the Colloquia and we are excited to celebrate this milestone by making this year our biggest and best yet.

Anyone interested is welcome to attend. Some funds are available to contribute to the expenses of attending research students.

Further details can be obtained from tiny.cc/Colloquia or from Rebecca Lumb (r.c.lumb@lse.ac.uk).

Support for this event by the London Mathematical Society and the British Combinatorial Committee is gratefully acknowledged.



#CC2016



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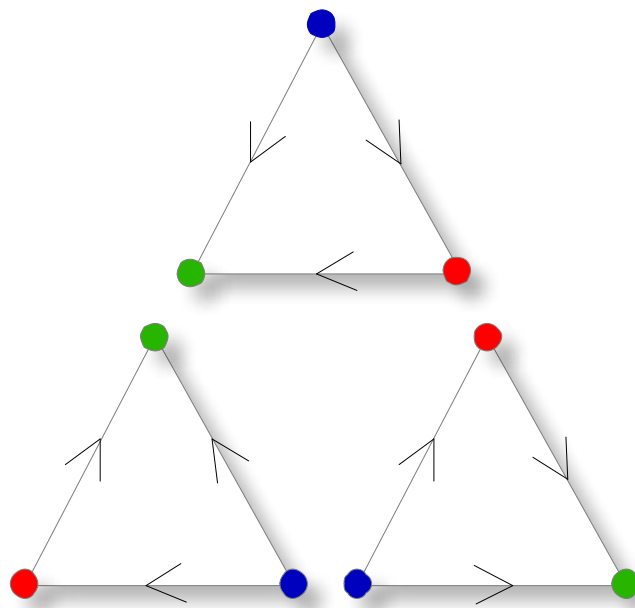
Queen Mary
University of London

Queen Mary, University of London

**The London School of Economics
and Political Science**

Two One-Day Colloquia in Combinatorics

11th and 12th May 2016



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

**In 2016, QMUL & LSE are celebrating
ten years of the Colloquia
in Combinatorics.**

**Thank you for joining us for our
tenth anniversary.**

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11	Places to eat at LSE and area map
12	LSE Campus map

INFORMATION

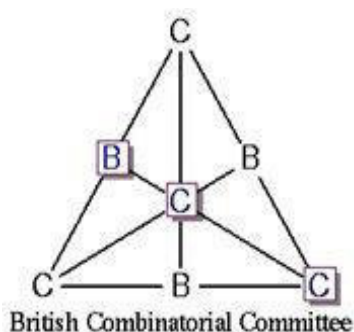
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Event organisers: Dr Julia Böttcher (LSE), Dr David Ellis (QMUL), Dr Robert Johnson (QMUL) and Dr Jozef Skokan (LSE).

SUPPORT

Support for this event from the London Mathematical Society (www.lms.ac.uk) and the British Combinatorial Committee (<https://britishcombinatorial.wordpress.com/>) is gratefully acknowledged.



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WEDNESDAY 11th MAY 2016

Schedule

The first day of the Colloquia in Combinatorics will be held at Queen Mary, University of London on Wednesday 11th May, starting at 10.30am. Everyone interested is welcome to attend any part of the event. All the talks will be held in the Fogg Lecture Theatre, G.E. Fogg Building, Mile End Campus, QMUL (please note this is a change to last year's venue – listed as 13 on page 6 map). Refreshment breaks will be taken in the Mathematical Sciences Building Foyer, Mile End, QMUL (4 on page 6 map); the reception will be held in the Senior Common Room, Queen's Building, Mile End, QMUL (19 on page 6 map).

Time	Speaker	Presentation title
10:00	Coffee (<i>Mathematical Science Building Foyer</i>)	
10:30	Béla Bollobás (Cambridge/ Memphis)	Problems and Results on Random Geometric Graphs
11:20	Karim Adiprasito (Jerusalem)	The Hodge-Riemann Relations in Combinatorics
12:10	Lunch (<i>own arrangements – options on campus and nearby</i>)	
13:30	Imre Leader (Cambridge)	Transitive Misere Games
14:20	Yufei Zhao (Oxford)	Quasirandom Cayley Graphs
15:10	Afternoon tea break (<i>Mathematical Science Building Foyer</i>)	
15:40	Andrew Granville (Montréal/UCL)	Smoothing Sieve Weights
16:30	David Conlon (Oxford)	Finite Reflection Groups and Graph Norms
17:30	Reception (<i>Senior Common Room, Queen's Building</i>)	

Problems and Results on Random Geometric Graphs

Béla Bollobás

Random geometric graphs have been around for almost as long as random graphs. In fact, it was E.N. Gilbert, the mathematician who introduced the binomial model $\mathcal{G}(n, p)$, who first proposed their study in 1961. A great many natural models of random geometric graphs have been studied, starting with the *Gilbert Disc Model* $\mathcal{D}(\mathbb{R}^n, r)$. The vertex set of a random graph $D_{n,r} \in \mathcal{D}(\mathbb{R}^n, r)$ is a Poisson process of density 1 in \mathbb{R}^n , and two vertices (points) are joined by an edge if their distance is at most r . For this model the basic task is to determine the values n and r such that a.s. the random graph $D_{n,r}$ has an infinite component, i.e. percolates.

In the lecture I shall consider problems concerning some of the basic models of random geometric graphs, and will present a number of results obtained jointly with Paul Balister, Amites Sarkar, Mark Walters and others.

The Hodge-Riemann Relations in Combinatorics

Karim Adiprasito

We discuss applications of Hodge theory, a part of algebraic geometry, to problems in combinatorics. We moreover discuss situations in which these deep algebraic theorems themselves can be shown combinatorially, extending our knowledge of cohomology of closed currents in toric varieties.

This is joint work with June Huh and Eric Katz.

Transitive Misère Games

Imre Leader

In the usual form of a combinatorial game, two players take turns to play moves in a set ('the board'), and certain subsets are designated as 'winning': the first person to occupy such a set wins the game. For these games, it is well known that (with correct play) the game cannot be a second-player win.

In the 'misère' form, the first person to occupy such a set loses the game. Here it would be natural to assume that the game cannot be a first-player win, at least if the game is transitive, meaning that all points of the board look the same. Our aim is to investigate this.

This is joint work with Robert Johnson and Mark Walters.

Quasirandom Cayley Graphs

Yufei Zhao

We prove that the properties of having small discrepancy and having small second eigenvalue are equivalent in Cayley graphs, extending a result of Kohayakawa, Rödl and Schacht, who treated the abelian case. The proof relies on a number of ingredients, including Grothendieck's inequality and non-abelian Fourier analysis. As a corollary, we also prove that a similar result holds in all vertex-transitive graphs.

Smoothing Sieve Weights

Andrew Granville

There are many analogies between the ‘anatomies’ of integers, of permutations and of polynomials in finite fields. The techniques used in the surprising recent proof by Maynard and Tao of bounded gaps between primes seemed very similar to what was already well-known and, we thought, understood. In this talk we report on investigations by Koukoulopoulos, Maynard and the speaker into the advantages of the weights used in that proof, and try to develop analogies in the combinatorics of permutations, and of polynomials in finite fields.

Finite Reflection Groups and Graph Norms

David Conlon

Given a graph H on vertex set $\{1, 2, \dots, n\}$ and a function $f : [0, 1]^2 \rightarrow \mathbb{R}$, define

$$\|f\|_H := \left| \int \prod_{ij \in E(H)} f(x_i, x_j) d\mu^{|V(H)|} \right|^{1/|E(H)|},$$

where μ is the Lebesgue measure on $[0, 1]$. We say that H is *norming* if $\|\cdot\|_H$ is a semi-norm. We also define a similar notion $\|\cdot\|_{r(H)}$ by $\|f\|_{r(H)} := \| \|f\|_H \|_H$, saying that H is *weakly norming* if $\|\cdot\|_{r(H)}$ is a norm.

Classical results show that weakly norming graphs are necessarily bipartite. In the other direction, Hatami showed that even cycles, complete bipartite graphs, and hypercubes are all weakly norming. Using results from the theory of finite reflection groups, we demonstrate that any graph which is edge-transitive under the action of a certain natural family of automorphisms is weakly norming. This result includes all previous examples of weakly norming graphs and adds many more. We also include several applications of our results. In particular, we define and compare a number of generalisations of Gowers' octahedral norms and we prove some new instances of Sidorenko's conjecture.

This is joint work with Joonkyung Lee.

PLACES TO EAT: in and around QMUL

Baghdad Café – Authentic Iraqi and Arabic food, Burdett Road

The Curve – international food to eat-in or take away, Westfield Way

Dirty Burger – burger joint, Mile End Road

Drapers Bar and Kitchen – wide range to suit all dietary requirements, Godward Square

Drunken Monkey – Asian fusion, Westfield Way

Greedy Cow – gastropub food, Grove Road

Half Moon Pub – Wetherspoons serving standard pub food, Mile End Road

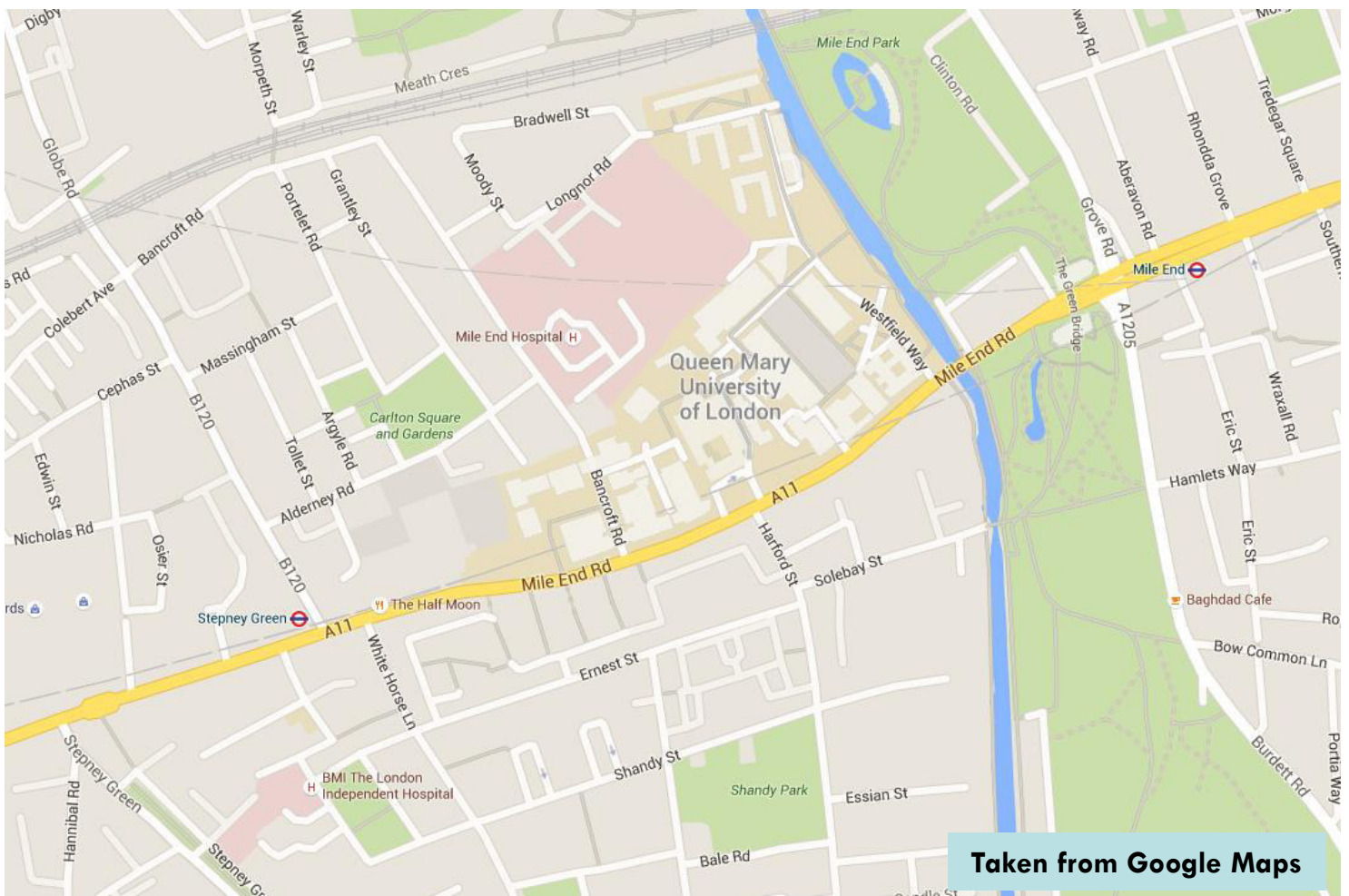
Morgan Arms – Up-market pub food, Morgan Street

Mucci's – Italian trattoria, Library Square














Nandos – Portuguese Chicken, Mile End Road

The Orange Room – Lebanese, Burdett Road

Tayyabs – Indian, Fieldgate Street



Mile End Campus

Educational/Research		Residential		Facilities		Information	
ArtsOne	37	Albert Stern Cottages	3	Advice and Counselling Service	27	 Information	Visitors who require further information or assistance should please go to the main reception in the Queens' Building.
ArtsTwo	35	Albert Stern House	1	Housing Hub	48		
Arts Research Centre	39	Beaumont Court	53	Bookshop 	22		
Bancroft Building	31	Chapman House	43	Careers Centre	19	 The smoking of cigarettes or tobacco products are only permitted at designated smoking areas / shelters indicated on this map.	
Bancroft Road Teaching Rooms	10	Chesney House	45	Clock Tower	20		
Computer Science	6	Creed Court	57	CopyShop	56		
Engineering Building	15	France House	55	The Curve  	47	 Electronic cigarettes permitted on outside spaces only .	
G.E. Fogg Building	13	Feilden House	46	Disability and Dyslexia Service	31		
G.O. Jones Building	25	Hatton House	40	Drapers' Bar and Kitchen 	8		
Geography	26	Ifor Evans Place	2	Canalside	63	 These premises are alarmed and monitored by CCTV; please call Security on +44 (0)20 7882 5000 for more information.	
Informatics Teaching Laboratories	5	Lindop House	21	Ground Café 	33		
Joseph Priestley Building	41	Lodge House	50	The Hive	24		
Library 	32	Lynden House	59	Infusion 	9	Key	
Law	36	Maurice Court	58	IT Services	19		
Lock-keeper's Cottage Graduate Centre	42	Maynard House	44	Mucci's 	29		
Mathematical Sciences	4	Pooley House	60	Occupational Health Service/ Student Health Service	28	 Library/bookshop	
Occupational Health and Safety Directorate	12	Selincourt House	51	Octagon	19a	 Fitness centre	
The People's Palace/Great Hall	16	Varey House	49	Portering and Postal Services	17	 Bar	
Queens' Building 	19			Qmotion Health and Fitness Centre	7	 Coffee place	
Temporary Building	61			Sports Hall 	62	 Eatery	
				Santander Bank 	38/54	 Staff car park	
				Security	23	 Bicycle parking	
				St Benet's Chaplaincy	34	 Bicycle lockers	
				Students' Union Hub	19	 Cash machine	
				Student Enquiry Centre	52	 Smoking area / shelter	
				Village Shop	11		
				Westfield Nursery			

New Graduate Centre construction site18

Engineering Building construction site64

No access between Geography Square and Bancroft Road before 8am and after 6.30pm Mon–Fri. Closed weekends.





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THURSDAY 12th MAY 2016

Schedule

The second day of the Colloquia in Combinatorics will be held at The London School of Economics and Political Science on Thursday 12th May, starting at 10.30am. Everyone interested is welcome to attend any part of the event. The talks will be held in Wolfson Theatre, New Academic Building, LSE (please note this is a change to last year's venue – listed as NAB on the LSE map on page 12). Refreshment breaks will be taken Lower Ground Floor Atrium, New Academic Building, LSE; the reception will be held on the 8th Floor, New Academic Building, LSE.

Time	Speaker	Presentation title
10:00	Coffee and arrival (<i>Lower Ground Floor Atrium, New Academic Building</i>)	
10:30	Daniela Kühn (Birmingham)	Packing Bounded Degree Graphs
11:20	Benny Sudakov (Zürich)	Equiangular Lines and Spherical Codes in Euclidean Spaces
12:10	Lunch (<i>own arrangements – options on campus and nearby</i>)	
13:30	Nati Linial (Jerusalem)	High-dimensional Permutations and Discrepancy
14:20	Monique Laurent (Amsterdam/ Tilburg)	Geometric Graph Realizations and Positive Semidefinite Matrix Completion
15:10	Afternoon tea break (<i>Lower Ground Floor Atrium, New Academic Building</i>)	
15:40	James Maynard (Oxford)	Primes with Missing Digits
16:30	Alan Frieze (Pittsburgh)	Biggs Lecture: Purchasing Under Uncertainty
17:30	Reception (<i>8th Floor, New Academic Building</i>)	

Packing Bounded Degree Graphs

Daniela Kühn

Questions on packings and decompositions have a long history, going back to the 19th century. For instance, the existence of Steiner triple systems (proved by Kirkman in 1847) corresponds to a decomposition of the edge set of the complete graph K_n on n vertices into triangles (if n satisfies the necessary divisibility conditions). There are several beautiful conjectures which have driven a large amount of research in this area. A prime example is the tree packing conjecture of Gyárfás and Lehel, which would guarantee a decomposition of a complete graph into a suitable given collection of trees. We develop a new method for constructing approximate decompositions of dense quasirandom graphs into bounded degree graphs. Our result can be viewed as an extension of the classical blow-up lemma of Komlós, Sárközy and Szemerédi to the setting of approximate decompositions. I will discuss this method and some of its applications.

This is joint work Jaehoon Kim, Deryk Osthus and Mykhaylo Tyomkyn.

Equiangular Lines and Spherical Codes in Euclidean Spaces

Benny Sudakov

A set of lines in \mathbb{R}^d is called *equiangular* if the angles between any two of them are the same. The problem of estimating the size of the maximum family of equiangular lines has had a long history since being posed by van Lint and Seidel in 1966. A closely related notion is that of a *spherical code*, which is a collection C of unit vectors in \mathbb{R}^d such that $x \cdot y \in L$ for any distinct x, y in C and some set of real numbers L . Spherical codes have been extensively studied since their introduction in the 1970's by Delsarte, Goethals and Seidel. Despite a lot of attention in the last forty years, there are still many open interesting questions about equiangular lines and spherical codes. In this talk we report recent progress on some of them.

This is joint work with I. Balla, F. Drexler and P. Keevash.

High-dimensional Permutations and Discrepancy

Nati Linial

This is part of our ongoing effort to develop what we call ‘High-dimensional combinatorics’. We equate a permutation with its permutation matrix, namely an $n \times n$ array of zeros and ones in which every line (row or column) contains exactly one 1. In analogy, a two-dimensional permutation is an $n \times n \times n$ array of zeros and ones in which every line (row, column or shaft) contains exactly one 1. It is not hard to see that a two-dimensional permutation is synonymous with a Latin square. It should be clear what a d -dimensional permutation is, and those are still very partially understood. We have already made good progress on several aspects of

this field. We mostly start from a familiar phenomenon in the study of permutations and seek its high dimensional counterparts. Specifically we consider:

- The enumeration problem;
- Birkhoff von-Neumann theorem and d -stochastic arrays;
- Erdős-Szekeres theorem and monotone subsequences;
- Discrepancy phenomena;
- Problems related to communication complexity;
- Random generation.

These results were obtained in collaboration with my students and ex-students: Zur Luria, Michael Simkin and Adi Shraibman

Geometric Graph Realizations and Positive Semidefinite Matrix Completion

Monique Laurent

We consider some graph parameters related to the positive semidefinite matrix completion problem. In particular, we investigate the Gram dimension of a graph, which is defined as the smallest integer k such that, for every assignment of unit vectors to the nodes of the graph, there exists another assignment of unit vectors lying in the k -dimensional space and having the same inner products on the edges of the graph. We present complexity results and structural characterizations of the class of graphs with Gram dimension at most 4. We also discuss links to Euclidean graph realizations in distance geometry and to some Colin de Verdière type graph parameters.

Primes with Missing Digits

James Maynard

We show that there are infinitely many primes with no 7 in their decimal expansion. (And similarly with 7 replaced by any other digit.) This shows the existence of primes in a thin set of numbers, since only $O(X^{0.96})$ integers less than X have no 7 in their decimal expansion. The proof relies on decorrelating ‘digit conditions’ which say when the Fourier transform of numbers with restricted digits is large, from ‘Diophantine conditions’ which say when the Fourier transform of the primes is large.

‘The Norman Biggs Lecture’

Purchasing Under Uncertainty

Alan Frieze

Suppose there is a collection x_1, x_2, \dots, x_N of independent uniform $[0, 1]$ random variables, and a hypergraph F of target structures on the vertex set $\{1, \dots, N\}$. We would like to buy a target structure at small cost, but we do not know all the costs x_i ahead of time. Instead, we inspect the random variables x_i one at a time, and after each inspection, choose to either keep the vertex i at cost x_i , or reject vertex i forever.

In this talk, we consider the case where $\{1, \dots, N\}$ is the edge-set of some graph, and the target structures are the spanning trees of a graph, the paths between a fixed pair of vertices, perfect matchings, Hamilton cycles or the cliques of some fixed size.

This is joint work with Wesley Pegden.



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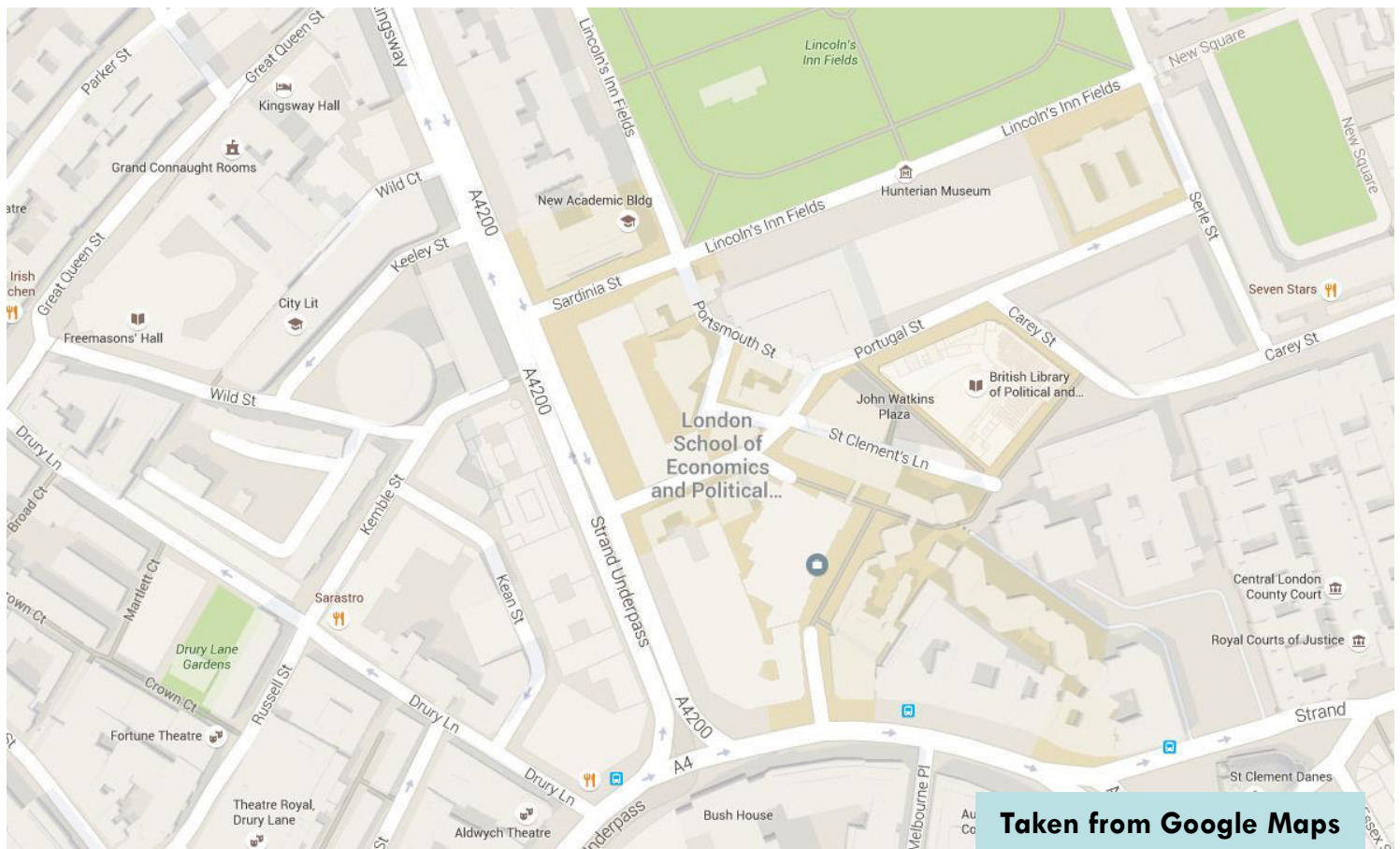
PLACES TO EAT: in and around LSE

Close by:

All Bar One – Kingsway
Belgo – Kingsway
Bill's – Kingsway
Café Amici – Kingsway
Café Nero – Kingsway
Costa – Kingsway
EAT – Kingsway
Paul – Kingsway
Pret a Manger – Kingsway
Sainsburys – Kingsway
Starbucks – Kingsway
Subway – Kingsway
The Delaunay Counter – Aldwych
Viet Eat – Kingsway
Wasabi – Kingsway

On campus:

The Bean Counter – 32 Lincoln's Inn Fields
Café 54 – New Academic Building
Daily Grind Coffee Shop – Tower One reception
Fields Bar and Kitchen – Lincoln's Inn Fields
Fourth Floor Café Bar – Old Building
Fourth Floor Restaurant – Old Building
George IV Pub – Portugal Street
LSE Garrick – Columbia House
Mezzanine Café – New Academic Building
Plaza Café – John Watkins Plaza
Three Tuns Bar – Saw Swee Hock Student Centre



Accessibility Map

- Disabled lift Lift
- Disabled parking (blue badge)
- Male accessible toilet
- Gender Neutral accessible toilets
- Disabled access Roads and Footpaths closed
- No entry Buildings under construction

Disabled access

After 6.30pm, please call Security Control on 020 7955 6200 to ensure that any disabled access doors are open.

Portable ramp for 20 Kingsway (**KSW** only) is located in entrance foyer. Please call 020 7955 6200 for Security staff to set up the ramp on request.

95A	95 Aldwych <i>Aldwych</i>
ALD	Aldwych House <i>Aldwych</i>
CLM	Clement House <i>Aldwych</i> .
COL	Columbia House <i>Aldwych</i>
CON	Connaught House <i>Aldwych</i>
COW	Cowdray House <i>Portugal Street</i>
KGS	King's Chambers <i>Portugal Street</i>
1KW	1 Kingsway
KSW	20 Kingsway
32L	32 Lincoln's Inn Fields
44L	44 Lincoln's Inn Fields (not occupied by LSE)
50L	50 Lincoln's Inn Fields <i>Portsmouth Street</i>
LCH	Lincoln Chambers <i>Portsmouth Street</i>
LAK	Lakatos Building <i>Portugal Street</i>
LRB	Lionel Robbins Building, Library
NAB	New Academic Building <i>Lincoln's Inn Fields</i>
OLD	Old Building <i>Houghton Street</i>
PAR	Parish Hall <i>Sheffield Street</i>
PEA	Peacock Theatre <i>Portugal Street</i>
POR	1 Portsmouth Street

QUE	Queens House <i>Lincoln's Inn Fields</i>	STC	St Clement's <i>Clare Market</i>
SAR	Sardinia House <i>Sardinia Street</i>	TW1	Tower One <i>Clement's Inn</i>
SAW	Saw Swee Hock Student Centre <i>Sheffield Street</i>	TW2	Tower Two <i>Clement's Inn</i>
SHF	Sheffield Street	TW3	Tower Three <i>Clement's Inn</i>



Student Services Centre
Ground floor, Old Building

Graham Wallis Room
OLD 5.25, Old Building

Hong Kong Theatre
Ground floor, Clement House

Old Theatre
Ground floor, Old Building

Shaw Library Sixth floor, Old Building

Sheikh Zayed Theatre
New Academic Building

Thai Theatre New Academic Building

The Wolfson Theatre
New Academic Building

The Venue
Basement, SAW

Vera Anstey Room
Between ground and first floor, Old Building
(Step free access is not available to this venue)

3 Tuns Ground floor, SAW

Bean Counter
Basement, 32 Lincoln's Inn Fields

Café 54
Ground floor, New Academic Building

Daily Grind Tower 1/2 Reception

Denning Learning Cafe
First floor, SAW

Fourth Floor Café Bar Old Building

Fourth Floor Restaurant
Old Building

George IV pub Portugal Street

LSE Garrick Ground floor, Columbia House

Mezzanine Café New Academic Building

Plaza Café John Watkins Plaza

Senior Common Room and Dining Room Fifth floor, Old Building

Student Common Room
Ground floor, King's Chambers

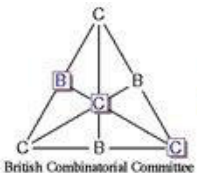
Weston Café Sixth floor, SAW



Get the discussion going: when tweeting about the Colloquia, please use the hashtag **#CC2016**

Follow us at:
@LSEMaths
@QMULMaths

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Report on 2016 Colloquia in Combinatorics

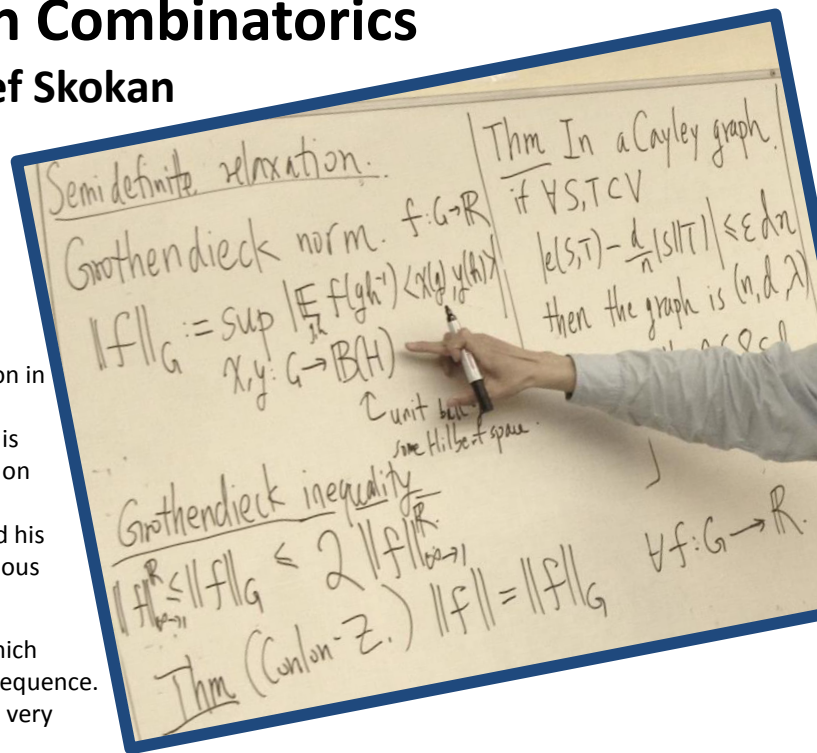
by Julia Böttcher & Jozef Skokan

Support for this event by the London Mathematical Society and the British Combinatorial Committee is gratefully acknowledged by the organisers.

The 2015/16 Colloquia followed the successful format established in the past: six invited talks were delivered on each of the two days. The meeting went according to plan, and our expectations were fully met. Most participants attended both days. The conference attracts both excellent speakers and a large audience, with participants coming from around the world.

The Queen Mary day started with an engaging talk by Béla Bollobás who spoke about percolation in various models of random geometric graphs. His results depend on proving bounds on the percolation threshold for the plane square lattice, where the probability measure on the bonds is not a product measure but has limited dependence. Interestingly, the strongest results depend on the evaluations of high-dimensional integrals whose values we cannot rigorously estimate. However using Monte Carlo methods one obtains a value with high confidence, so that Béla and his co-authors prove that with high probability they know the correct percolation thresholds in various geometric models.

Karim Adiprasito presented his exciting result, confirming the Heron-Rota-Welsh conjecture, which states that the coefficients of the characteristic polynomial of any matroid form a log-concave sequence. The proof of this result uses deep ideas from algebraic geometry but, as Karim explained, is of a very combinatorial nature.



Imre Leader's talk focused on combinatorial games, a topic on the border between combinatorics and game theory. He lectured on the existence of winning strategies of the first or second player in Misère games, and in particular highlighted the difference in applicability of strategy stealing arguments in Misère games compared to the more usual combinatorial games with winning sets.

Afterwards Yufei Zhao lectured on Cayley graphs, a topic with elements from both combinatorics and group theory. He talked about when Cayley graphs are quasirandom, proving that the well-studied discrepancy property and eigenvalue property are equivalent for all Cayley graphs, which was before only known for Cayley graphs of abelian groups.

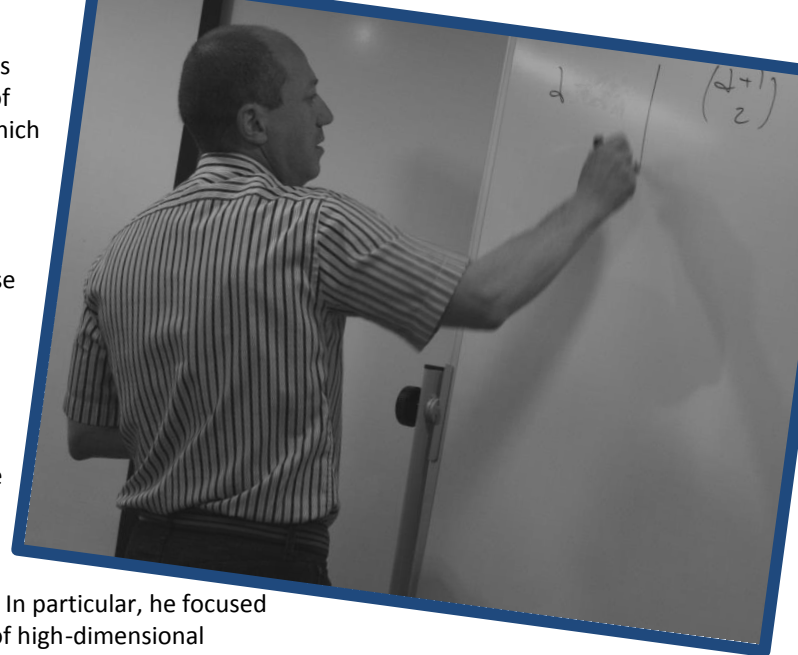
The topic of Andrew Granville's talk concerned recently developed and powerful methods in number theory and their application to the study of classical combinatorial objects. He outlined the advances concerning the famous twin prime conjecture in the last decade, and explained his investigations connected to a better understanding of the methods that drove these developments. He also discussed connections to results concerning the structure of permutations and polynomials in finite fields.

The last lecture of the day, by David Conlon, addressed the study of graph norms. This topic brings together elements from functional analysis and graph theory, and is closely related to the study of graph limits. He explained how reflection groups give rise to new examples of norming graphs, which is also connected to the well-known Sidorenko conjecture in graph theory and to the theory of quasirandom graphs.

Daniela Kühn opened the LSE day; her talk was on graph packing problems, a topic in extremal combinatorics with much recent progress. She talked about the development of a general purpose tool for solving long-standing conjectures in the area, a packing version of the so-called blow-up lemma. In particular this tool allows confirming a number of well-known tree packing conjectures for bounded-degree trees.

Benny Sudakov's lecture was on geometric problems. He discussed the question of determining bounds on the number of equiangular lines in the d -dimensional Euclidean space, when the angle is predetermined. This combined techniques from combinatorics, linear algebra, and spectral theory, and allows generalisations of the results to spherical codes.

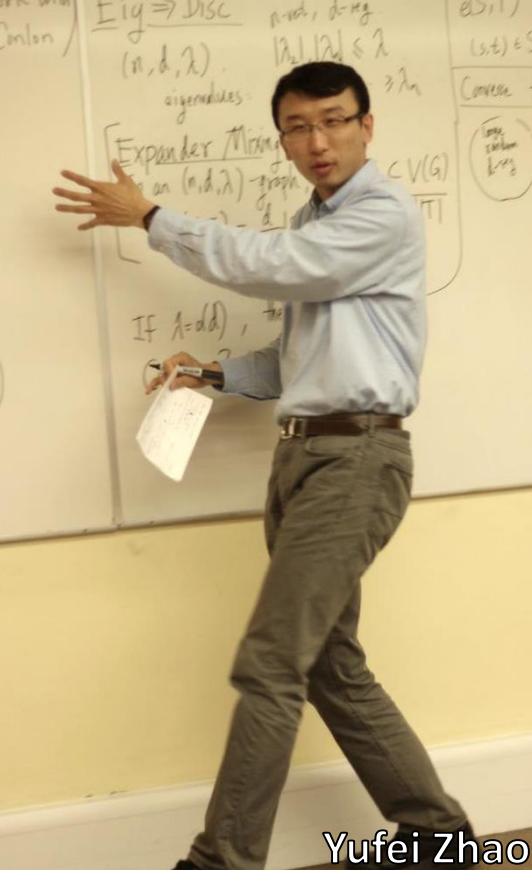
Nati Linial gave a lecture on the relatively young but rich area of high-dimensional combinatorics. In particular, he focused on higher-dimensional analogues of permutations and Latin squares. This is related to the study of high-dimensional expanders, which recently sparked much interest, and to questions in communication complexity. He explained that the enumerative properties and the typical behaviour of these objects are not yet well understood, but presented first important results and conjectures in this direction.



Monique Laurent's talk concerned the completion of positive semidefinite matrices. She focused in particular on two graph parameters arising in this context: the Gram dimension and the extremal Gram dimension of a graph. She explained how this is related to problems in distance geometry and problems from combinatorial optimisation, that it also has interesting connections to certain spectral graph parameters and presented new results in the area.

James Maynard's talk was of a number theoretical nature and concerned the problem of finding primes in thin sets without multiplicative structure. In particular he presented a new result stating that the set of (decimal) numbers with one excluded digit contains infinitely many primes. He also outlined the proof, which combines discrete Fourier analysis, Markov processes, sieve theory, and results about the geometry of numbers.

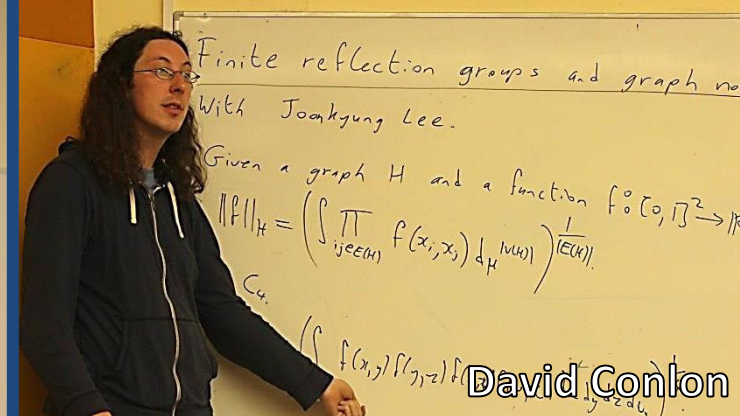
The meeting ended with Biggs Lecture delivered by Alan Frieze. Alan discussed an online purchasing game, in which the edges of a graph are given random costs and must be bought or rejected on-line in order to construct a specified subgraph as cheaply as possible. This is closely related to the famous Secretary Problem. The results depend on a careful interplay between strategy design and random graph theory.



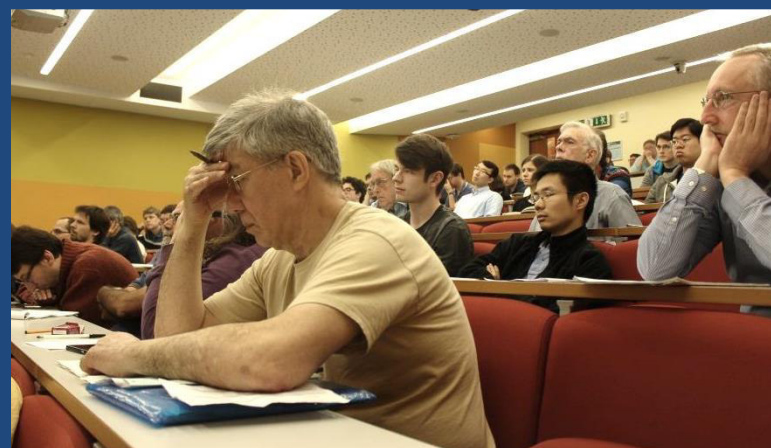
Yufei Zhao



Karim Adiprasito



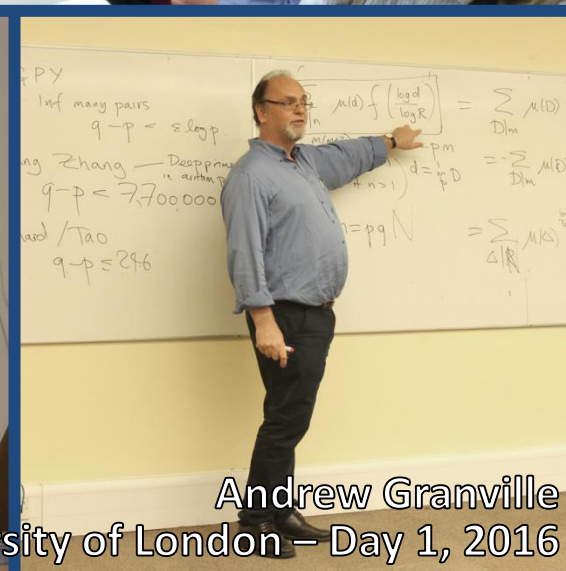
David Conlon



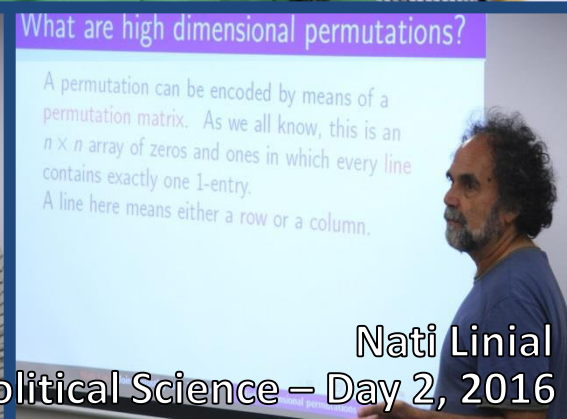
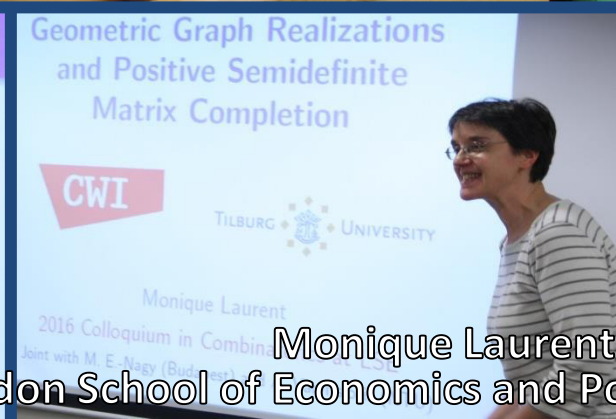
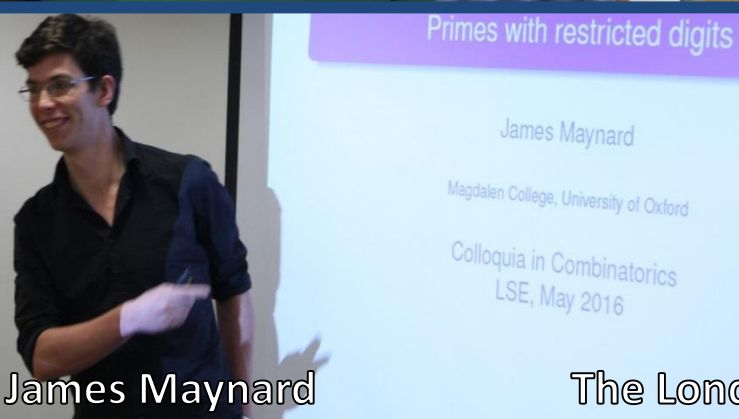
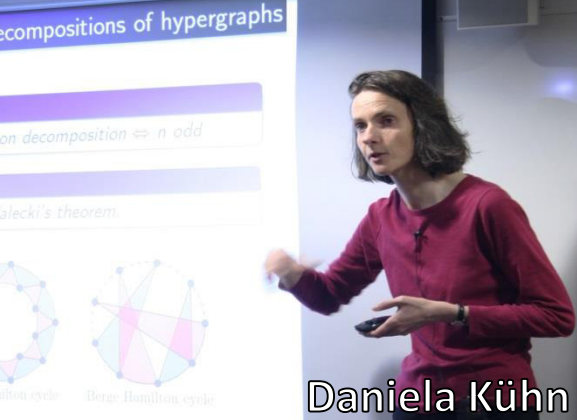
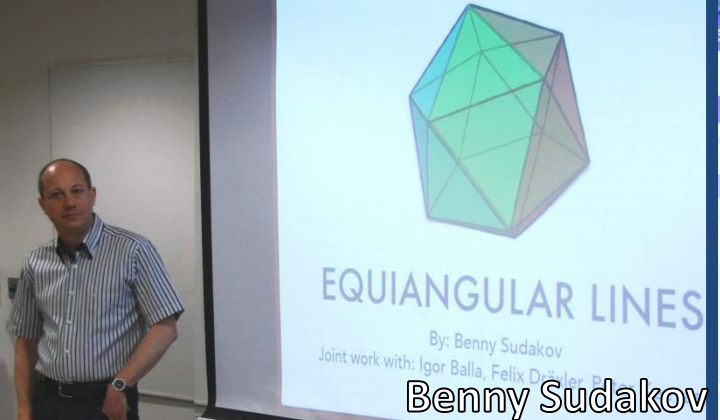
Imre Leader



Béla Bollobás
Queen Mary University of London – Day 1, 2016



Andrew Granville
Queen Mary University of London – Day 1, 2016



The London School of Economics and Political Science – Day 2, 2016

