Meeting of the Swedish, Spanish and Catalan Mathematical Societies
Umeå, June 12 – June 15, 2017
Special session: Graphs, Hypergraphs and Set Systems
Preliminary Program

Tuesday June 13

Time	Speaker	Talk title
14.00–14.40	Svante Linusson	*Reverse juggling and a model on random matrices over a finite field*
14.40–15.00	Lan Anh Pham	*Avoiding/completing precoloring of hypercubes*
15.00–15.30	Klas Markström	*tba*
15.30–16.00		**COFFEE BREAK**
16.00–16.30	Matas Šileikis	*Embedding the Erdős-Rényi graph into the regular random graph*
16.30–17.00	Andrew Treglown	*Independent sets in hypergraphs and Ramsey properties of graphs and the integers*
17.00–17.40	Yi Zhao	*Degree versions of the Erdős–Ko–Rado and Hilton–Milner theorems*

Wednesday June 14

Time	Speaker	Talk title
14.00–14.30	Shagnik Das	*Small semi-random covering arrays*
14.30–15.00	Fiona Skerman	*Guessing numbers of odd cycles*
15.00–15.30	Erik Thörblad	*Limits of tournaments*
15.30–16.00		**COFFEE BREAK**
16.00–16.30	Guillem Perarneau	*Sparse versions of the Ryser–Brualdi–Stein conjecture*
16.30–17.00	Pieter Trapman	*End of an SIR epidemic on a configuration model network*
17.00–17.30	Xing-Shi Cai	*Large fringe and non-fringe subtrees in conditional Galton–Watson trees*

Thursday June 15

Time	Speaker	Talk title
14.00–14.40	Johan Jonasson	*Topic models and mixing times*
14.40–15.00	Joel Larsson	*Biased random k-SAT*
15.00–15.30	Carl-Johan Casselgren	*Kempe equivalence of edge colorings*
15.30–16.00		**COFFEE BREAK**

Abstracts for Tuesday June 13

Reverse juggling and a model on random matrices over a finite field

Svante Linusson (KTH, Stockholm)

I will describe a Markov chain model where a state is a matrix over a finite field. In each transition a new column is added to the left. This model is naturally modelled by what we call reverse juggling, and which was recently studied by Knutsen. In joint work with Arvind Ayyer, we generalise this in several ways.

Avoiding/completing precoloring of hypercubes

Lan Anh Pham (Umeå Universitet)

Completing a precolouring of a hypercube graph Q_n means, given a precolour at some edges of Q_n, the question is: can we can colour the remaining edges with some restricted number of colours such that no two adjacent edges share the same colour?

Avoiding a precolouring of a hypercube graph Q_n means, given a list of colours size cn (with $c < 1$) at every edges of Q_n, the question is: can we colour the edges of Q_n with n colours such that the colour given to each edge does not belong to the list of (forbidden) colours at that edge and no two adjacent edges share the same colour?

We try to solve these problems using techniques previously used for completing/avoiding Latin squares.

TBA

Klas Markström (Umeå Universitet)

TBA

Embedding the Erdős-Rényi graph into the regular random graph

Matas Šileikis (Charles University Prague)

We will consider the following statement. There is a joint distribution of the d-regular random graph $R(n, d)$ and the Erdős-Rényi random graph $G(n, p)$ with expected degrees asymptotically equal to d such that $G(n, p)$ is a subgraph of $R(n, d)$ asymptotically almost surely. A necessary assumption for this is that $d = d(n)$ grows faster than $\log n$. Such a statement allows transfering increasing properties of the graph $G(n, p)$ to the more restrictive graph $R(n, d)$. We will also consider a gereneralization to random (uniform) hypergraphs and its consequence for Hamiltonicity.

Independent sets in hypergraphs and Ramsey properties of graphs and the integers

Andrew Treglown (University of Birmingham)

Many important problems in combinatorics and other related areas can be phrased in the language of independent sets in hypergraphs. Recently Balogh, Morris and Samotij, and independently Saxton and Thomason developed very general container theorems for independent sets in hypergraphs; both of which have seen numerous applications to a wide range of problems. In this talk

we apply the container method to Ramsey-type problems. For example, we generalise the random Ramsey theorem of Rödl and Ruciński by providing a resilience analogue. This result also implies the random version of Turán's theorem due to Conlon and Gowers, and Schacht.

This is joint work with Robert Hancock and Katherine Staden.

Degree versions of the Erdős–Ko–Rado and Hilton–Milner theorems

Yi Zhao (Georgia State University, Atlanta)

A family of sets is intersecting if any two members have a nonempty intersection. We call an intersecting family trivial if all of its members have a nonempty intersection. Let X be a set of n elements. The celebrated Erdős–Ko–Rado theorem (EKR) says that whenever $n \geq 2k$, the maximum size of an intersecting family of k-subsets of X is attained by trivial intersecting families. The Hilton–Milner theorem says that the maximum size of a nontrivial intersecting family of k-subsets of X is attained by the family HM, which consists a fixed k-set S and all k-subsets of X that contains a fixed element $x \in X \setminus S$ and at least one element from S. We prove a minimum degree version of the EKR, which implies the EKR as a corollary. We also prove a degree version of the Hilton–Milner theorem for $n > 30k^2$.

These are joint works with Peter Frankl, Jie Han and Hao Huang.

Abstracts for Wednesday June 14

Small semi-random covering arrays

Shagnik Das (Freie Universität Berlin)

Given a set S of $v \geq 2$ symbols, and integers $k \geq t \geq 2$ and $N \geq 1$, an $N \times k$ array $A \in S^{N \times k}$ is an $(N; t, k, v)$-covering array if all sequences in S^t appear as rows in every $N \times t$ subarray of A. These arrays have a wide variety of applications, driving the search for small covering arrays. The covering array number, $CAN(t, k, v)$, is the smallest N for which an $(N; t, k, v)$-covering array exists. In this talk we shall combine probabilistic and algebraic arguments to construct small covering arrays, improving the bounds on $CAN(t, k, v)$.

This is joint work with Tamás Mészáros.

Guessing numbers of odd cycles

Fiona Skerman (Uppsala Universitet)

For a given number of colours, s, the guessing number of a graph is the base s logarithm of the size of the largest family of colourings of the vertex set of the graph such that the colour of each vertex can be determined from the colours of the vertices in its neighbourhood.

We show that, for any given integer $s > 2$, if a is the largest factor of s less than or equal to $\sqrt{s}$, for sufficently large odd n, the guessing number of the cycle C_n with s colours is $(n-1)/2 + log_s(a)$. This answers a question posed by Christofides and Markström in 2011.

Guessing numbers are related to index coding and our results show that the information defect of the coding problem where the side information is a large odd cycle is $(n+1)/2log_s(a)$.

Joint work with Ross Atkins and Puck Rombach.

Limits of tournaments

Erik Thörblad (Uppsala Universitet)

In this talk I will describe the limit theory of tournaments (directed complete graphs). After setting up the basics, I will talk about how to extend some classical results on tournaments to the setting of tournament limits. In particular I will describe how Landau's theorem on admissible degree sequences for tournaments extends to a theorem on admissible degree functions for tournament limits.

Sparse versions of the Ryser–Brualdi–Stein conjecture

Guillem Perarneau (University of Birmingham)

The Ryser–Brualdi–Stein conjecture states that every Latin square of size n has a latin transversal of size $n-1$. This conjecture is equivalent to finding a rainbow matching of size $n-1$ in a properly edge-coloured complete bipartite graph $K_{n,n}$. In this talk, we will discuss the existence of a rainbow perfect matching on an edge-coloured bipartite graph G, provided that each colour appears a bounded number of times on the edges of G.

Parts of this talk are joint work with P. Cano and O. Serra, with A. Ferber and R. Nenadov and with M. Coulson.

End of an SIR epidemic on a configuration model network

Pieter Trapman (Stockholm Universitet)

We consider an SIR (Susceptible-Infective-Recovered) epidemic on a static (configuration model) random graph. We describe the final stages of the epidemic and analyse the time until extinction of the epidemic. Furthermor, we consider the effect of control measures, such as vaccination on the duration of the epidemic. The analysis heavily relies on theory on branching processes.

We show that the epidemic is always exponentially declining in the final stages, even if the degree distribution of the network has infinite variance. Furthermore, we show that control measures, although decreasing the size of the epidemic, might well increase the duration of the epidemic, which might have serious public health and economic implications.

Joint work with Ana Serafimovic and Abid Ali Lashari.

Large fringe and non-fringe subtrees in conditional Galton–Watson trees

Xing-Shi Cai (Uppsala Universitet)

One particularly attractive random tree model is the tree chosen uniformly at random from a collection of trees. Many of these models are equivalent to the Galton–Watson tree conditional on its size — these trees, in turn, go back to the model proposed by Bienaymé, Watson and Galton for the evolution of populations.

We study the conditions for families of subtrees to exist with high probability (whp) in a Galton–Walton tree of size n. We first give a Poisson approximation of fringe subtree counts, which yields the height of the maximal complete r-ary fringe subtree. Then we determine the maximal K_n such that every tree of size at most K_n appears as a fringe subtree whp. Finally, we study non-fringe subtree counts and determine the height of the maximal complete r-ary non-fringe subtree.

Abstracts for Thursday June 15

Topic models and mixing times

Johan Jonasson (Chalmers)

MCMC and in particular Gibbs sampling is ubiquitous in Bayesian machine learning models. In this talk I will shortly review the Latent Dirichlet Allocation model for text classification and a hidden Markov model thereof. The task is to infer topics from the text in an unsupervised way and a common way is to use collapsed Gibbs sampling (i.e. integrating out the unknown random parameters). It would be desirable to have these to converge fast, but we show examples of where this is not the case

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Biased random k-SAT

Joel Larsson (Umeå Universitet)

TBA

Kempe equivalence of edge colorings

Carl-Johan Casselgren (Linköping Universitet)

Two proper k-edge colorings f and g are *kempe equivalent* if one can be obtained from the other by a sequence of interchanges, i.e. by repeatedly switching colors on maximal connected two-colored subgraphs of G.

Mohar used the edge coloring algorithm suggested by Vizing to prove that for a graph G, all proper t-edge colorings of G are Kempe equivalent if $t \geq \chi'(G) + 2$, where $\chi'(G)$ denotes the chromatic index of a graph, and posed the question whether all $(\chi'(G) + 1)$-edge colorings of a graph G are Kempe equivalent. McDonald, Mohar and Scheide proved that this problem has an affirmative answer for all graphs with maximum degree 3, and also for all Class 2 graphs with maximum degree 4.

We prove that if G is a Class 1 graph with maximum degree $\Delta(G) = 4$, then all proper 5-edge colorings of G are Kempe equivalent, and if G is a Class 2 graph with $\Delta(G) = 5$, then all proper 7-edge colorings of G are Kempe equivalent.

This is joint work with A.S. Asratian.
