ICGT 2018

10th International Colloquium on Graph Theory and combinatorics

July 9-13, 2018
Lyon, France

Abstract book

Contents

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ICGT 2018

10th International Colloquium on Graph Theory and combinatorics, Lyon, July 9-13, 2018

Time	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
8h30 – 9h30	WELCOME - REGISTRATION (coffee)				
9h – 10h		Z. Dvořák	L. Babai	S. Fiorini	C. Mathieu
9h30 – 10h30	C. Thomassen	(coffee)	(coffee)	(coffee)	(coffee)
Morning sessions (Amphi 7 / 8 / 9 / 10 / 11)	21, 69, 129 / 8, 9, 15 / 32, 40, 47 / 61, 103, 115 / –	80, 81, 98 / 102, 111, 104 / 5, 34, 83 / 28, 29, 120 / –	11, 16, 22, 23 / 12, 13, 30, 35 / 10, 43, 85, 128 / 123, 112, 130, 41 / 19, 97, 62, 64	45, 74, 136 / 25, 44, 107 / 76, 78, 92 / 49, 86, 122 / 113, 127, 135	31, 24, 48 / 101, 109, 125 / 26, 39, 87 / 131, 46, 14 / –
12h – 14h	(lunch)	(lunch)	(lunch)	(lunch)	(lunch)
14h – 15h	D. Kühn	M. Chudnovsky	SEMINAR - L. BABAI	D. Lokshtanov	D. Král
15h – 15h15			SOCIAL EVENT : VISIT OF LYON		END OF ICGT 2018
15h15 – 16h05 (Amphi 7 / 8 / 9 / 10 / 11)	71, 77 / 54, 52 / 36, 73 / 4, 60 / 137, tba	17, 56 / 95, 108 / 51, 124 / 50, 55 / 20, 84		66, 99 / 68, 100 / 75, 91 / 63, 89 / 114, 7	
16h05 – 16h30	(coffee)	(coffee)		(coffee)	
16h30 – 17h45 (Amphi 7 / 8 / 9 / 10 / 11)	105, 96, 116 / 58, 59, 33 / 132, 133, 134 / 42, 82, 110 / –	OPEN PROBLEMS SESSION		90, 119, 57 / 3, 118, 6 / 93, 94, 67 / 88, 27, 70 / –	
18h – 19h	« COCKTAIL DINATOIRE » Welcoming reception (Domus building)		CONFERENCE DINNER		

Rooms:

- Amphi 7
- Amphi 8
- Amphi 9
- Amphi 10
- Amphi 11

Invited talks

Carsten Thomassen: From finite to countable to uncountable

Technical University of Denmark
When: Monday morning

A classical result discovered independently by Edmonds, Nash-Williams and Tutte says that every finite $2k$-edge-connected graph has k pairwise edge-disjoint spanning trees. As a consequence, every finite $4k$-edge-connected graph has a k-arc-connected orientation. Nash-Williams proved that $4k$ can be replaced by $2k$. We discuss the possible extension of these and other basic results on finite graphs to the countable case or the uncountable case, in particular a decomposition result of François Laviolette that allows extensions from the countable to the uncountable case. We also discuss the conjecture made by Erdős and Hajnal in 1966 that every graph of uncountable chromatic number has a subgraph of infinite connectivity. Daniel Soukup has obtained counterexamples to the vertex-connectivity version. We present (at least a sketch of) a proof of the edge-connectivity version of the conjecture.

Daniela Kühn: On a conjecture of Erdos on locally sparse Steiner triple systems

University of Birmingham
When: Monday afternoon

Given a set X of size n, a collection S of 3-subsets of X is a Steiner triple system of order n if every 2-subset of X is contained in exactly one of the triples of S (so a Steiner triple system of order n can also be viewed as a decomposition of the n-vertex complete graph into edge-disjoint triangles). A famous theorem of Kirkman says that there exists a Steiner triple system of order n if and only if n equals 1,3 mod 6. In 1976, Erdos conjectured that one can find so-called "sparse" Steiner triple systems. Roughly speaking, the aim is to have at most j-3 triples in S on every set of j points, which would be best possible. (Triple systems with this sparseness property are also referred to as having high girth.)

We prove this conjecture asymptotically by analysing a natural generalization of the random triangle removal process. Our result also solves a problem posed by Lefmann, Phelps and Rodl as well as Ellis and Linial in a strong form. Moreover, we pose a conjecture which would generalize the Erdos conjecture to Steiner systems with arbitrary parameters and provide some evidence for this.

In my talk I will also survey some related decomposition problems.

(joint work with Stefan Glock, Allan Lo and Deryk Osthus)

Zdeněk Dvořák: Graph Minors without the Structure Theorem

Charles University, Prague
When: Tuesday morning

The Excluded Minor Structure Theorem of Robertson and Seymour is a powerful tool in the theory of proper minor-closed classes. On the flip side, its applications tend to be quite technical and lack real-world relevance due to huge constants involved in the process. We review several recent results on proper minor-closed classes that avoid these issues.

Maria Chudnovsky: Trees and the Erdös-Hajnal conjecture

Princeton University
When: Tuesday afternoon

What is the effect of excluding an induced subgraph on the global structure of a graph? While there do not seem to be general structural consequences, a conjecture of Erdos and Hajnal states that graphs with forbidden induced subgraphs behave very differently from general graphs; more precisely they contain much larger cliques or stable sets. This conjecture is still open. We consider a stronger (but closely related) property. We say that a graph G has the "strong Erdos-Hajnal property" (with parameter epsilon) if it has two disjoint sets of vertices A and B, each of which contains epsilon-proportion of the vertex set of G, and such that either there are no edges between A and B, or every vertex of A is adjacent to every vertex of B. It is not hard to see that if all H-free graphs have the strong EH-property (with some fixed epsilon), then both H and H^c are forests, and Liebenau and Pilipczuk conjectured that this is, in some sense, if and only if. Their conjecture states that for every forest H, every (H, H^c)-free graph has the strong Erdos Hajnal property. Recently in joint work with Alex Scott, Paul Seymour and Sophie Spirkl we proved their conjecture. In this talk we will discuss the history of the problem, and some of the ideas of the proof.

László Babai: From local information to global symmetry: The Graph Isomorphism Problem

University of Chicago
When: Wednesday morning

Deciding whether two finite graphs are isomorphic has long been known as one of a small number of natural computational problems with unsettled complexity status within the P/NP theory.

We build on a group theoretic "Divide and Conquer" framework introduced in a seminal 1980 paper by Eugene M. Luks. Recent progress on the problem centers on an interplay between local information and global symmetry.

The talk will attempt to illuminate this interplay.

László Babai: Hidden irregularity vs. hidden symmetry: The emergence of the Johnson graphs

University of Chicago
When: Wednesday afternoon

We describe in some detail the "Split-or-Johnson" routine, one of the combinatorial ingredients of the recent Graph Isomorphism tester. The algorithm either finds hidden irregularity in a graph or finds a canonically embedded highly symmetrical object: a Johnson graph. The work centers on highly regular partitions of the directed complete graph called "coherent configurations."

Samuel Fiorini: Graphs and extended formulations

Université libre de Bruxelles
When: Thursday morning

In the area of extended formulations, the main goal is to represent complicated convex sets as the projection of simpler convex sets. This is already interesting for polytopes. In order to quantify how succinctly a given polytope can be expressed as a projection of another polytope, one defines the extension complexity of a polytope P as the minimum number of facets of a polytope Q that projects to P. Many interesting polytopes are based on graphs (like for instance the spanning tree polytope, the matching polytope, or the stable set polytope), and it is interesting to see how the extension complexity of such polytopes depends on the structure of the graph. In the first part of my talk, I will give a quick overview of the field of extended formulations as we know it today, as well as state a few selected open problems, with a special emphasis on polytopes defined from graphs. In the second part, I will discuss how graphs appear beyond the scenes. In particular, I will discuss how they were used to obtain lower bounds on extension complexity or, in recent joint work with Marco Macchia and Kanstantsin Pashkovich, parametrize a class of polytopes that generalize stable set polytopes of perfect graphs.

Daniel Lokshtanov: The number of things in things

University of Bergen
When: Thursday afternoon

How many maximal independent sets can a graph on n vertices possibly have? Moon and Moser showed in 1965 that no graph can have more than $3^{n/3}$ maximal independent sets, and that there exist graphs which have this many. In this talk we will survey old and new results of this kind for a wide range of combinatorial objects - from minimal separators and induced paths in graphs, to minimal satisfying assignments to a formula in 3-CNF. We will look into some of the techniques that are used to obtain upper bounds on the number of things in things, and, if time permits, point to applications of these bounds in parameterized and exact exponential time algorithms.

Claire Mathieu: Hierarchical Clustering: Objective Functions and Algorithms

CNRS, École Normale Supérieure de Paris
When: Friday morning

Hierarchical clustering is a recursive partitioning of a dataset into clusters at an increasingly finer granularity. Motivated by the fact that most work on hierarchical clustering was based on providing algorithms, rather than optimizing a specific objective, Dasgupta (2016) framed similarity-based hierarchical clustering as a combinatorial optimization problem, where a 'good' hierarchical clustering is one that minimizes some cost function. He showed that this cost function has certain desirable properties, such as in order to achieve optimal cost disconnected components must be separated first and that in 'structureless' graphs, i.e., cliques, all clusterings achieve the same cost. We take an axiomatic approach to defining 'good' objective functions for both similarity and dissimilarity-based hierarchical clustering. We characterize a set of admissible objective functions (that includes the one introduced by Dasgupta) that have the property that when the input admits a 'natural' ground-truth hierarchical clustering, the ground-truth clustering has an optimal value.

Equipped with a suitable objective function, we analyze the performance of practical algo- rithms, as well as develop better and faster algorithms for hierarchical clustering. For similarity- based hierarchical clustering, Dasgupta (2016) showed that a simple recursive sparsest-cut based approach achieves an $O(\log^{3/2} n)$-approximation on worst-case inputs. We give a more re- fined analysis of the algorithm and show that it in fact achieves an $O(\sqrt{\log n})$-approximation. This improves upon the LP-based $O(\log n)$-approximation of Roy and Pokutta (2016). For dissimilarity-based hierarchical clustering, we show that the classic average-linkage algorithm gives a factor 2 approximation, and provide a simple and better algorithm that gives a factor 3/2 approximation. This aims at explaining the success of this heuristics in practice. Finally, we consider 'beyond-worst-case' scenario through a generalisation of the stochastic block model for hierarchical clustering. We show that Dasgupta's cost function also has desirable properties for these inputs and we provide a simple algorithm that for graphs generated according to this model yields a $1 + o(1)$ factor approximation.

This is joint work with Vincent Cohen-Addad, Varun Kanade, and Frederik Mallmann-Trenn.

Daniel Král: Analytic methods in graph theory

University of Warwick
When: Friday afternoon

The range of applications of analytic methods in graph theory has been growing continually. In this talk, we focus on two closely linked topics, where analytic tools have played a crucial role: the flag algebra method, which has changed the landscape of extremal combinatorics, and the theory of graph limits, which has provided analytic tools to study large graphs and shed new light on various problems in computer science and mathematics. We will present an introduction to these rapidly developing areas of graph theory and survey some of the recent results.

Selected talks

Paper 3:

Recent developments in reconstruction of infinite graphs

Nathan Bowler, Joshua Erde, Peter Heinig, Florian Lehner and Max Pitz

Abstract: Two graphs G and H are hypomorphic if there is a bijection $\phi\colon V(G) \to V(H)$ such that $G - v \cong H - \phi(v)$ for each $v \in V(G)$. A graph G is reconstructible if $H \cong G$ for all H hypomorphic to G.

The question whether all locally finite connected graphs are reconstructible had remained open for the past 50 years. The Harary-Schwenk-Scott Conjecture from 1972 suggests that all locally finite trees are reconstructible. By work of Bondy and Hemminger ('74), Thomassen ('78) and Andreae ('81), every tree with at most countably many ends is reconstructible. Nash-Williams ('87 & '91) proved that locally finite graphs with a finite number ≥ 2 of ends are reconstructible.

In this talk, I aim to sketch our recent construction of a non-reconstructible tree, and explain how one can modify our tree-construction to obtain non-reconstructible locally finite graphs with one and countably many ends respectively, complementing the results of Nash-Williams.

Paper 4:

Existence of Simple (q, k, λ) BIBDs with q congruent to 1 modulo $k(k-1)$

Hsin-Min Sun

Abstract: We study the existence of simple (q, k, λ) BIBDs when the number of elements q is a prime power. We show that in many situations the necessary conditions $(k-1)$ divides $\lambda(q-1)$, $k(k-1)$ divides $\lambda q(q-1)$, and λ is less than or equal to the binomial coefficient $C(q-2, k-2)$ are also sufficient for the existence of a simple (q, k, λ) BIBD. Here we focus on the cases when q is congruent to 1 modulo $k(k-1)$.

Paper 5:

Isoperimetry in integer lattices

Joshua Erde and Ben Barber

Abstract: The edge isoperimetric problem for a graph G is to determine, for each n, the minimum number of edges leaving any set of n vertices. In general this problem is NP-hard, but exact solutions are known in some special cases, for example when G is the usual integer lattice. We solve the edge isoperimetric problem asymptotically for every Cayley graph on $\mathbb{Z}^d$. The near-optimal shapes that we exhibit are zonotopes generated by line segments corresponding to the generators of the Cayley graph.

Paper 6:

On Min-max Pair in Tournaments

Xiaoyun Lu

Abstract: We prove the following result in this paper.

Theorem: Let $T = (V(T), E(T))$ be a tournament of order $n \geq 3$, x a vertex of maximum out-degree and y a vertex of minimum out-degree of T. If $yx \in E(T)$ then there exists a path of length i from x to y for any i with $2 \leq i < n$; and if $xy \in E(T)$, then there exists a path of length i from x to y for any i with $3 \leq i < n$ unless T is in an exception class.

From this we obtain the following well-known results.

Corollary 1: (Alspach) If e is an arc of a regular tournament of order $n \geq 3$, then e is contained in cycles of all lengths m with $3 \leq m \leq n$.

Corollary 2: (Alspach et al) If $e = xy$ is an arc of a regular tournament of order $n \geq 7$, then there exists a path from x to y of length m for all m with $3 \leq m < n$.

Paper 7:

Sequential Metric Dimension

Julien Bensmail, Dorian Mazauric, Fionn Mc Inerney, Nicolas Nisse and Stéphane Pérennes

Abstract: Seager introduced the following game in 2013. An invisible and immobile target is hidden at a vertex t of a graph G. Every step, one vertex of G can be probed, informing us of its distance to t. The goal is to locate t, whatever vertex it be, in the minimum number of steps.

We address the generalization of this game where $k \geq 1$ vertices can be probed at every step. Precisely, given a graph G and two integers $k, \ell \geq 1$, the LOCALIZATION Problem asks if there exists a strategy to locate a target hidden in G in at most ℓ steps by probing at most k vertices per step. We show that this problem is NP-complete when k (resp., ℓ) is a fixed parameter.

In the class of trees, we show that Localization is NP-complete when k and ℓ are part of the input. Despite this, we design a polynomial-time (+1)-approximation algorithm in trees. It follows that Localization is polynomial-time solvable in trees if k is fixed.

Paper 8:

On the identifying code number of block graphs

Gabriela Argiroffo, Silvia Bianchi, Yanina Lucarini and Annegret Wagler

Abstract: The identifying code problem is a search problem that is challenging both from a theoretical and a computational point of view, even for several graphs where other in general hard problems are easy to solve, like bipartite graphs or chordal graphs. Hence, a typical line of attack for this problem is to determine minimum identifying codes of special graphs. In this work we study the problem of determining the cardinality of a minimum identifying code in block graphs (that are diamond-free chordal graphs). We present a linear time algorithm for this problem, as a generalization of a linear

time algorithm proposed by Auger in 2010 for the case of trees. Thereby, we provide a subclass of chordal graphs for which the identifying code problem can be solved in linear time. In addition, we discuss an upper bound for the identifying code number of block graphs, state a corresponding conjecture and verify it for some cases.

Paper 9:

On Stronger Types of Locating-dominating Codes

María Luz Puertas, Ville Junnila, Tero Laihonen and Tuomo Lehtilä

Abstract: We present some results about γ^{SLD} and γ^{DLD}, the parameters associated to self-locating-dominating codes and solid-locating-dominating codes in graphs. Both stronger types of locating-dominating codes where recently introduced following the ideas of self-identifying codes. We study these parameters in special graph families, such are trees and Cartesian product of graphs. We also present results about the relationship between each of them and the well-known locating dominating number.

Paper 10:

Total mixed domination number of a graph

Adel Kazemi Piledaraq and Farshad Kazemnejad

Abstract: A subset $S \subseteq V \cup E$ of a graph G is a total mixed dominating set of G if each element of $V \cup E$ is either adjacent or incident to an element of S. The total mixed domination number $\gamma_{tm}(G)$ of G is the minimum cardinality of a total mixed dominating set. Here, we talk on this concept which is initiated its studying in [**?**].

Paper 11:

The minimum number of triangles in graphs of given order and size

Hong Liu, Oleg Pikhurko and Katherine Staden

Abstract: Rademacher (1941; unpublished) asked for the minimum number of triangles in a graph of given order and size, and solved this problem in the first non-trivial case when the size is by 1 larger than the Turan number of the triangle. This problem was revived by Erdos in the 1950s and has attracted much attention since then. In a major breakthrough, Razborov solved it asymptotically in 2008. We provide an exact solution for all large graphs whose edge density is bounded away from 1, confirming a conjecture of Lovasz and Simonovits from 1975 in this range.

Paper 12:

A rainbow blow-up lemma

Felix Joos and Stefan Glock

Abstract: We prove a rainbow version of the blow-up lemma of Komlós, Sárközy and Szemeredi for cn-bounded edge colourings. This enables the systematic study of rainbow embeddings of bounded degree spanning subgraphs. As one application, we show how our blow-up lemma can be used to transfer the bandwidth theorem of Böttcher, Schacht and Taraz to the rainbow setting. Our proof methods include the strategy of an alternative proof of the blow-up lemma given by Rödl and Rucinski, the switching method, and the partial resampling algorithm developed by Harris and Srinivasan.

Paper 13:

On minimal triangle-free 6-chromatic graphs

Jan Goedgebeur

Abstract: A graph with chromatic number k is called k-chromatic. Using computational methods, we show that the smallest triangle-free 6-chromatic graphs have at least 32 and at most 40 vertices.

We also determine the complete set of all triangle-free 5-chromatic graphs up to 24 vertices. This implies that Reed's conjecture holds for triangle-free graphs up to at least 24 vertices. Next to that, we determine that the smallest regular triangle-free 5-chromatic graphs have 24 vertices. Finally, we show that the smallest 5-chromatic graphs of girth at least 5 have at least 29 vertices and that the smallest 4-chromatic graphs of girth at least 6 have at least 25 vertices.

Paper 14:

Maximizing Hamming Distance in Contraction of Permutation Arrays

Ivan Sudborough, Sergey Bereg, Zevi Miller, Luis Mojica and Linda Morales

Abstract: Let $M(n, d)$ be the largest cardinality of any set of permutations on n symbols with pairwise Hamming distance d. Two important examples of permutation arrays for the study of $M(n, d)$ are the Affine General Linear Group $AGL(1, q)$ acting on the finite field $GF(q)$ of size q, and the Projective Linear Group $PGL(2, q)$ acting on the set $GF(q) \cup \infty$ of size $q + 1$. Lower bounds for $M(q-1, q-3)$ and $M(q, q-3)$ have been shown when q is not congruent to $1(mod 3)$. Here we consider the case when q is congruent to $1(mod 3)$. We give lower bounds for $M(q-1, q-3)$ if $q > 6$, and when q is odd for $M(q, q-3)$ if $q > 12$.

Paper 15:

On a Conjecture regarding Identification in the Hamming Graphs

Tuomo Lehtilä, Ville Junnila and Tero Laihonen

Abstract: Identifying codes were introduced by Karpovsky *et al.* (1998) and have been widely studied since then. Goddard and Wash (2013) studied them in the Cartesian products of complete graphs and provided a conjecture for three equal complete graphs stating that $\gamma^{ID}(K_q \square K_q \square K_q) = q^2$. In this article, we present an infinite family of counterexamples to this conjecture showing that $\gamma^{ID}(K_q \square K_q \square K_q) \leq q^2 - q/4$ when q is a power of four. Goddard and Wash also showed a lower bound $\gamma^{ID}(K_q \square K_q \square K_q) \geq q^2 - q\sqrt{q}$. We improve this lower bound to $\gamma^{ID}(K_q \square K_q \square K_q) \geq q^2 - \frac{3}{2}q$. Moreover, we also show that $\gamma^{ID}(K_q^n) \leq q^{n-k}$ for $n = 3\frac{q^k-1}{q-1}$ improving the previous upper bound $\gamma^{ID}(K_q^n) \leq q^{n-1}$ by Goddard and Wash

Paper 16:

On the maximum size of connected hypergraphs without a path of given length

Nika Salia, Ervin Gyori, Abhishek Methuku, Casey Tompkins and Máté Vizer

Abstract: In this note we asymptotically determine the maximum number of hyperedges possible in an r-uniform, connected n-vertex hypergraph without a Berge path of length k, as n and k tend to infinity. We show that, unlike in the graph case, the multiplicative constant is smaller with the assumption of connectivity.

Paper 17:

Enumeration of Unsensed Orientable and Non-Orientable Maps

Aleksandr Omelchenko and Evgeniy Krasko

Abstract: The work is devoted to enumeration of unlabelled maps on orientable or non-orientable surfaces up to all their homeomorphisms. On the first step we classify all periodic orientation-reversing homeomorphisms of orientable genus g surfaces. Then we derive recurrence relations for quotient maps on orbifolds corresponding to such homeomorphisms, which allows us to enumerate reflexive maps on orientable surfaces. Combining these results with the results obtained by Mednykh and Nedela for sensed maps, we enumerate unsensed maps on orientable surfaces of a given genus. Then we apply an analogous approach to enumerate periodic homeomorphisms of non-orientable surfaces with g crosscaps. By counting quotient maps on orbifolds corresponding to such homeomorphisms we obtain the numbers enumerating unsensed maps on non-orientable surfaces.

Paper 18:

Isolation Number of Maximal Outerplanar Graphs

Pawaton Kaemawichanurat and Thiradet Jiarasuksakun

Abstract: A subset S of vertices in a graph G is called an isolating set if $V(G) \setminus N_G[S]$ is an empty set or is an independent set of G. The isolation number $\iota(G)$ is the minimum cardinality of an isolating set of G. Let G be a maximal outerplanar graph of order n with k vertices of degree 2. It was previously proved that $\iota(G) \leq \frac{n}{4}$. In this paper, we improve this bound in terms of n and k to be

$$\iota(G) \leq \begin{cases} \frac{n+k}{5} & when \;\; k \leq \frac{n}{4}, \\ \\ \frac{n-k}{3} & otherwise, \end{cases}$$

and these bounds are best possible.

Paper 19:

Feasibility of the Clustered Spanning Tree Problem

Michal Stern, Nili Guttmann-Beck and Zeev Sorek

Abstract: Let $H =< G, \mathcal{S} >$ be a hypergraph, where $G = (V, E)$ is a weighted complete undirected graph and $\mathcal{S}$ is a set of non-disjoint clusters $S_i \subseteq V$. The optimum Clustered Spanning Tree problem is to find an optimum spanning tree such that each cluster induces a subtree. In this paper we provide different techniques for the feasibility decision problem on the unweighted version of G. The first technique can handle every instance hypergraph and is based on finding a maximum spanning tree in a new defined weighted version of G. The weights of the edges in the graph are defined according to the number of clusters containing each edge. All other techniques consider the intersection graph of H to decide whether a feasible solution exists. When applicable, these techniques achieve better complexity, as the intersection graph is significantly smaller compared with the original graph.

Paper 20:

Pebble Exchange on Graphs and Graph Automorphism

Tomoki Nakamigawa, Tatsuoki Kato and Tadashi Sakuma

Abstract: A graph puzzle Puz(G) of a graph G is defined as follows. A configuration of Puz(G) is a bijection from the set of vertices of a board graph G to the set of vertices of a pebble graph G. A move of pebbles is to exchange two pebbles which are adjacent on both a board graph and a pebble graph. For two configurations f and g, we say that f is equivalent to g if f can be transformed into g by a sequence of finite moves. Let Aut(G) be the automorphism group of G, and let 1_G be the unit element of Aut(G). The pebble exchange group of G, denoted by Peb(G), is defined as the set of all automorphisms f of G such that 1_G and f are equivalent to each other. In this paper, some basic properties of Peb(G) are studied. Among other

results, it is shown that for any connected graph G, all automorphisms of G are contained in $\mathrm{Peb}(G^2)$, where G^2 is a square graph of G.

Paper 21:

A general decomposition theory for the 1-2-3 Conjecture and locally irregular decompositions

Olivier Baudon, Julien Bensmail, Tom Davot, Hervé Hocquard, Jakub Przybyło, Mohammed Senhaji, Éric Sopena and Mariusz Woźniak

Abstract: The 1-2-3 Conjecture is one of the most popular open problems in graph distinguishing labellings. It claims that we can weight the edges of any graph G with no isolated edge with weights in 1,2,3 in such a way that every two adjacent vertices of G get different sums of their respective incident weights.The 1-2-3 Conjecture has recently been investigated from a decomposition angle,via so-called locally irregular decompositions,which are edge-partitions into locally irregular subgraphs.Through several recent studies, it was shown that this concept is quite related to the 1-2-3 Conjecture.However, the full connection between all these concepts was not clear.In this work, we propose an approach that generalizes all concepts above,involving coloured weights and sums.As a consequence, we get another interpretation of several existing results related to the 1-2-3 Conjecture.We also come up with new conjectures,to which we give some support.

Paper 22:

Turan numbers of theta graphs

Boris Bukh and Michael Tait

Abstract: The theta graph $\Theta_{\ell,t}$ consists of two vertices joined by t vertex-disjoint paths of length ℓ each. For fixed odd ℓ and large t, we show that the largest graph not containing $\Theta_{\ell,t}$ has at most $c_\ell t^{1-1/\ell} n^{1+1/\ell}$ edges and that this is tight apart from the value of c_ℓ.

Paper 23:

A strengthening of the Murty-Simon Conjecture for diameter 2 critical graphs

Antoine Dailly, Florent Foucaud and Adriana Hansberg

Abstract: A *diameter 2 edge-critical graph*, noted D2C graph, is a graph of diameter 2 and such that the deletion of any edge increases the diameter. The Murty-Simon Conjecture states that all D2C graphs of order n have at most $\lfloor \frac{n^2}{4} \rfloor$ edges and that this bound is only reached by the balanced complete bipartite graph. The conjecture has been proved for several families and when the order is either small or very large.

In 2015, a smaller bound of $\lfloor (n-1)^2/4 \rfloor + 1$ was proved for non-bipartite triangle-free D2C graphs, the extremal family being certain inflations of C_5. This opens the question of strengthening the Murty-Simon Conjecture. We propose the following strengthening: for every positive integer c, there exists an integer n_0 such that every non-bipartite D2C graph of order $n \geq n_0$ has less than $\lfloor \frac{n^2}{4} \rfloor - c$ edges. We prove this strengthened conjecture for $c = 1$ on D2C graphs with a dominating edge.

Paper 24:

On the upper broadcast domination number of caterpillars

Sabrina Bouchouika, Isma Bouchemakh and Éric Sopena

Abstract: A broadcast on a connected graph G is a function $f : V(G) \longrightarrow \{0, \ldots, \mathrm{diam}(G)\}$, where $\mathrm{diam}(G)$ denotes the diameter of G, such that $f(v) \leq e(v)$ for every vertex v of G, where $e(v)$ denotes the eccentricity of v. The upper broadcast domination number of a graph, denoted $\Gamma_b(G)$, is the maximum value of $\sum_{v \in V(G)} f(v)$ among all broadcasts f on G for which each vertex of the graph is within distance $f(v)$ from some vertex v with $f(v) \geq 1$. We determine the exact value of the upper broadcast domination number of a special class of regular caterpillars and of caterpillars without trunks.

Paper 25:

Inverting the Turán problem

Christopher Cox and Joseph Briggs

Abstract: Classical questions in extremal graph theory concern the asymptotics of $\mathrm{ex}(G, \mathcal{H})$ where $\mathcal{H}$ is a fixed family of graphs and $G = G_n$ is taken from a "standard" increasing sequence of host graphs $(G_1, G_2, \dots)$, most often K_n or $K_{n,n}$. Inverting the question, we can instead ask how large $|E(G)|$ can be with respect to $\mathrm{ex}(G, \mathcal{H})$. We show that the standard sequences indeed maximize $|E(G)|$ for some choices of $\mathcal{H}$, but not for others. Many interesting questions and previous results arise very naturally in this context, which also, unusually, gives rise to sensible extremal questions concerning multigraphs and non-uniform hypergraphs.

Paper 26:

On contact graphs of paths on a grid

Zakir Deniz, Esther Galby and Bernard Ries

Abstract: Golumbic et al. introduced in [1] the class of Vertex intersection graphs of Paths on a Grid (VPG graphs), i.e. graphs for which there exists a collection of nontrivial paths on a grid, referred to as a representation, in one-to-one correspondance with their vertex set, such that two vertices are adjacent if and only if the corresponding paths intersect on at least one grid-point. In this paper we consider a natural subclass of VPG graphs, namely that of Contact graphs of Paths on a Grid (CPG graphs): the class CPG consists of those VPG graphs admitting a representation in which paths are pairwise interiorly disjoint. We examine this class from a structural point of view which leads to constant uppper bounds on the clique number, the chromatic number and the clique chromatic number. We further investigate the relation between planar and CPG graphs and show that CPG graphs are not necessarily planar and not all planar graphs are CPG.

Paper 27:

Algebraic connectivity of multigraphs

Suil O

Abstract: For a pair of vertices u and v, let $m(u, v)$ be the number of edges with endpoints u and v. For a vertex v, let $m(v) = \max_{u \in N(v)} m(v, u)$, where $N(v)$ is the set of neighbors of v, and let $m(G) = \max_{v \in V(G)} m(v)$. We prove that for any multigraph G whose underlying graph is not a complete graph, $\mu_2(G) \leq \kappa(G)m(G)$. This extends a Fiedler's result.

We also prove that for any d-regular multigraph G whose underlying graph is not the complete graph with 2 vertices, if $\mu_2(G) > \frac{d}{4}$, then G is 2-connected. For $t \geq 2$ and infinitely many d, we construct d-regular multigraphs H with $\mu_2(H) = d$, $\kappa(H) = t$, and $m(H) = \frac{d}{t}$. These graphs show that the inequality $\mu_2(G) \leq \kappa(G)m(G)$ is sharp. In addition, we prove that if G is a d-regular multigraph whose underlying graph is not a complete graph, then $\mu_2(G) \leq d$; equality holds for the graphs in the construction.

Paper 28:

The class of (P_7, C_4, C_5)-free graphs: decomposition, algorithms, and χ-boundedness

Kathie Cameron, Shenwei Huang, Irena Penev and Vaidy Sivaraman

Abstract: As usual, P_n ($n \geq 1$) denotes the path on n vertices, and C_n ($n \geq 3$) denotes the cycle on n vertices. For a family $\mathcal{H}$ of graphs, we say that a graph G is *$\mathcal{H}$-free* if no induced subgraph of G is isomorphic to any graph in $\mathcal{H}$. We present a decomposition theorem for the class of (P_7, C_4, C_5)-free graphs; in fact, we give a complete structural characterization of (P_7, C_4, C_5)-free graphs that do not admit a clique-cutset. We use this decomposition theorem to show that the class of (P_7, C_4, C_5)-free graphs is χ-bounded by a linear function (more precisely, every (P_7, C_4, C_5)-free graph G satisfies $\chi(G) \leq \frac{3}{2}\omega(G)$). We also use the decomposition theorem to construct an $O(n^3)$ algorithm for the minimum coloring problem, an $O(n^2m)$ algorithm

for the maximum weight stable set problem, and an $O(n^3)$ algorithm for the maximum weight clique problem for this class.

Paper 29:

On Characterising and Recognising g_B-Perfect Graphs

Stephan Dominique Andres and Edwin Lock

Abstract: The vertex colouring game g_B is played on a simple graph with k permissible colours. Two players, Alice and Bob, take turns to colour an uncoloured vertex such that adjacent vertices receive different colours. Bob makes the first move. The game ends once, the graph is fully coloured, in which case Alice wins, or the graph can no longer be fully coloured, in which case Bob wins. A graph is g_B-perfect if for every induced subgraph H, the game g_B played on H admits a winning strategy for Alice with only $\omega(H)$ colours, where $\omega(H)$ denotes the clique number of H. We characterise g_B-perfect graphs in two ways, by forbidden induced subgraphs and by explicit structural descriptions. We also present a clique module decomposition, allowing us to efficiently recognise g_B-perfect graphs.

Paper 30:

An asymptotic bound for the strong chromatic number

Allan Lo and Nicolás Sanhueza Matamala

Abstract: The strong chromatic number $\chi_s(G)$ of a graph G on n vertices is the least number r with the following property: after adding $r\lceil n/r \rceil - n$ isolated vertices to G and taking the union with any collection of spanning disjoint copies of K_r in the same vertex set, the resulting graph has a proper vertex-colouring with r colours.

We show that for every $c > 0$ and every graph G on n vertices with maximum degree at least cn, $\chi_s(G) \leq (2 + o(1))\Delta(G)$, which is asymptotically best possible.

Paper 31:

Spanning trees without adjacent vertices of degree 2

Kasper Lyngsie and Martin Merker

Abstract: Albertson, Berman, Hutchinson, and Thomassen showed in 1990 that for every natural number k there exists a k-connected graph of which every spanning tree contains vertices of degree 2. Using a result of Alon and Wormald, we show that there exists a natural number d such that every graph of minimum degree at least d contains a spanning tree without adjacent vertices of degree 2. Moreover, we prove that every graph with minimum degree at least 3 has a spanning tree without three consecutive vertices of degree 2.

Paper 32:

Stable gonality is computable

Marieke van der Wegen and Ragnar Groot Koerkamp

Abstract: Stable gonality is a multigraph parameter that measures the complexity of a graph. It is defined using maps to trees. Those maps, in some sense, divide the edges equally over the edges of the tree; stable gonality asks for the map with the minimum number of edges mapped to each edge of the tree. This parameter is related to treewidth, but unlike treewidth, it distinguishes multigraphs from their underlying simple graphs. Stable gonality is relevant for problems in number theory. In this paper, we give an algorithm that computes the stable gonality of a graph in $O((1.33n)^n m^m poly(n,m))$ time.

Paper 33:

A characterization of testable hypergraph properties

Felix Joos, Jaehoon Kim, Daniela Kuhn and Deryk Osthus

Abstract: We provide a combinatorial characterization of all testable properties of k-graphs (i.e. k-uniform hypergraphs). Here, a k-graph property P is testable if there is a randomized algorithm which makes a bounded number of edge queries and distinguishes with probability 2/3 between k-graphs that satisfy P and those that are far from satisfying P.

For the 2-graph case, such a combinatorial characterization was obtained by Alon, Fischer, Newman and Shapira. Our results for the k-graph setting are in contrast to those of Austin and Tao, who showed that for the somewhat stronger concept of local repairability, the testability results for graphs do not extend to the 3-graph setting.

Paper 34:

On kissing numbers in high dimensions

Matthew Jenssen, Felix Joos and Will Perkins

Abstract: We prove a lower bound of $\Omega(d^{3/2} \cdot (2/\sqrt{3})^d)$ on the kissing number in dimension d. This improves the classical lower bound of Chabauty, Shannon, and Wyner by a linear factor in the dimension. We obtain a similar linear factor improvement to the best known lower bound on the maximal size of a spherical code of acute angle θ in high dimensions.

Paper 35:

On S-packing edge-colorings of cubic graphs

Nicolas Gastineau and Olivier Togni

Abstract: Given a non-decreasing sequence $S = (s_1, s_2, ..., s_k)$ of positive integers, an S-packing edge-coloring of a graph G is a partition of the edge set of G into k subsets $\{X_1, X_2, ..., X_k\}$ such that for each $1 \leq i \leq k$, the distance between two distinct edges e,e' in X_i is at least $s_i + 1$. This work studies S-packing edge-colorings of cubic graphs. Among other results, we prove that cubic graphs having a 2-factor are (1,1,1,3,3)-packing edge-colorable.

Paper 36:

Even Cycles in Dense Graphs

Neal Bushaw, Andrzej Czygrinow and Jangwon Yie

Abstract: Understanding the cycle structure of graphs has long been of great interest to graph theorists. For instance, it is elementary to show that every graph contains a cycle of length at least its minimum degree (this has been proven in the first week of every graph theory course I've ever attended). Adding a connectivity condition gives much more: Dirac's Theorem says that every 2-connected graph of minimum degree d contains a cycle of length min2d,|G|. When we add a 2-connectivity condition, our graphs not only contain long cycles, but cycles of many different lengths. And so, we must explore the cycle spectrum of 2-connected graphs: the set of cycle lengths appearing in the graph. In this talk, we'll tell a little bit of the history of results on the cycle spectrum, as well as present some new results on the even cycle spectrum of large 2-connected graphs (in particular, proving in a strong form the dense case of a conjecture of Faudree, Gould, Jacobson, and Magnant).

Paper 39:

Semistrong matching and semistrong edge-coloring

Borut Lužar, Martina Mockovčiaková and Roman Soták

Abstract: A proper edge-coloring of a graph in which every color class is an induced matching is called a *strong edge-coloring*. Here, we consider a related edge-coloring with relaxed conditions.A matching M of a graph G is *semistrong* if every edge of M has an end-vertex of degree one in the induced subgraph $G[M]$. A *semistrong edge-coloring* of a graph G is a proper edge-coloring in which every color class induces a semistrong matching.This notion was initiated by Gyárfás and Hubenko in 2005, who determined the equality between the sizes of maximum induced matchingsand maximum semistrong matchings in Kneser and subset graphs.We present a survey of the two types of edge-colorings, give the upper bound for the semistrong chromatic index of general graphs,and tight bounds for trees and graphs with maximum degree 3.

Paper 40:

Tree-like distance colouring for planar graphs of sufficient girth

Ross J. Kang and Willem van Loon

Abstract: Given a multigraph G and a positive integer t, the distance-t chromatic index of G is the least number of colours needed for a colouring of the edges so that every pair of distinct edges connected by a path of fewer than t edges must receive different colours.Let $\pi'_t(d)$ and $\tau'_t(d)$ be the largest values of this parameter over the class of planar multigraphs and of (simple) trees, respectively, of maximum degree d.We have that $\pi'_t(d)$ is at most and at least a non-trivial constant multiple larger than $\tau'_t(d)$.We prove for odd t the existence of a quantity g depending only on t such that the distance-t chromatic index of any planar multigraph of maximum degree d and girth at least g is at most $\tau'_t(d)$ if d is sufficiently large.Such a quantity does not

exist for even t.We also show a related, similar phenomenon for distance vertex-colouring.

Paper 41:

Strong cliques and forbidden cycles

Wouter Cames van Batenburg, Ross J. Kang and François Pirot

Abstract: Given a graph G, a *strong clique* of G is a collection of edges of G every pair of which are incident or connected by an edge in G; the *strong clique number* $\omega_2'(G)$ of G is the cardinality of a largest such collection. We study the strong clique number of graphs missing some set of cycle lengths. Among other results, we show the following: $\omega_2'(G) \leq 5\Delta(G)^2/4$ if G is triangle-free; $\omega_2'(G) \leq 3(\Delta(G)-1)$ if G is C_4-free; $\omega_2'(G) \leq \Delta(G)^2$ if G is C_5-free (where $\Delta(G)$ denotes the maximum degree of G). These bounds are attained by natural extremal examples. Our work extends and improves upon previous work of Faudree, Gyárfás, Schelp and Tuza (1990), Mahdian (2000) and Faron and Postle (2017). We are motivated by the corresponding problems for the strong chromatic index.

Paper 42:

Cuts in matchings of 3-edge-connected cubic graphs

Petru Valicov and Kolja Knauer

Abstract: We discuss relations between several known (some false, some open) conjectures on 3-edge-connected, cubic graphs and how they all fit into the same framework related to cuts in matchings. We then provide a construction of 3-edge-connected digraphs satisfying the property that for every even subgraph E, the graph obtained by contracting the edges of E is not strongly connected. This disproves a recent conjecture of Hochstättler [A flow theory for the dichromatic number. *European Journal of Combinatorics*, 66, 160–167, 2017]. Moreover, we provide experimental evidence for these conjectures and discuss on tools that might be helpful to search for counterexamples.

Paper 43:

Graphs whose size of all maximal 2-regular subgraphs are the same

Somayeh Khalashi Ghezelahmad and Saieed Akbari

Abstract: In this paper, we study graphs whose size of all maximal 2-regular subgraphs are the same. We call these graphs equi-2-regular. We characterize regular graphs which are equi-2-regular. We study claw-free equi-2-regular graphs. Moreover, a family of 2-connected equi-2-regular graphs is constructed.

Paper 44:

On dense bipartite induced subgraphs

Louis Esperet, Ross Kang and Stéphan Thomassé

Abstract: We conjecture that every triangle-free graph of minimum degree d contains a bipartite induced subgraph of minimum degree $\Omega(\log d)$ as $d \to \infty$. In this extended abstract, we present some results on this conjecture. In particular we prove that the conjecture holds for (nearly) regular graphs, and also for graphs with high average degree (as a function of n). In the general case we also prove a "half" version of the statement, where we only ask one of the two parts of the bipartition to induce a stable set.

Paper 45:

Graceful difference labelings of disjoint directed cycles

Christophe Picouleau and Alain Hertz

Abstract: A graceful difference labeling of a directed graph G with vertex set V is a bijection $f : V \to \{1, \ldots, |V|\}$ such that, when each arc uv is assigned the difference label $f(v) - f(u)$, the resulting arc labels are distinct. We are interested in the case of a disjoint unions of directed cycles. When $G = n\overrightarrow{\mathbf{C_3}}$, i.e. a collection of n directed triangles $n \geq 1$, we show that G has a graceful difference labeling if and only if $n \neq 1$.

Paper 46:

A bandwidth theorem for approximate decompositions

Padraig Condon, Jaehoon Kim, Daniela Kühn and Deryk Osthus

Abstract: We provide a degree condition on a regular n-vertex graph G which ensures the existence of a near optimal packing of any family $\mathcal{H}$ of bounded degree n-vertex k-chromatic separable graphs into G. In general, this condition is best possible.

Here a graph is separable if it has a sublinear separator whose removal results in a set of components of sublinear size. Equivalently, this condition can be replaced by that of having small bandwidth. Thus our result can be viewed as a version of the bandwidth theorem of Böttcher, Schacht and Taraz in the setting of approximate decompositions.

As an example, our result implies that if $\mathcal{H}$ is a family of bounded degree n-vertex trees with $|\mathcal{H}| \leq (1-o(1))d/2$ and G is any d-regular n-vertex graph with $d \geq (1 + o(1))n/2$, then $\mathcal{H}$ packs into G. This yields an approximate version of the tree packing conjecture of Gyárfás and Lehel in the setting of regular host graphs of high degree.

Paper 47:

Marking game and graph operators

Gabrielle Paris, Paul Dorbec, Éric Sopena and Elzbieta Sidorowicz

Abstract: Since its introduction, the graph marking game has been largelystudied. Indeed, its graph parameter, the *game coloring number*,is a natural upper bound for the *game chromatic number*, as themarking game is a colorblind version of the graph coloring game.
Understanding how it changes when the graph is modified is a fieldthat could answer different problems for the game chromatic number. Thisproblem has already been partially studied by Zhu in 1998 and Sia in2009. Here we study more deeply this question. More precisely, westudy how the game coloring number changes when we delete a vertex oran edge. We also study the contraction of edges, the union of twographs and the Cartesian product. Moreover, we show that our boundsare tight and give example of infinite families of graphs attainingthese bounds. These graphs in fact form a larger family that weintroduce as the *class of sunflowers*.

Paper 48:

Eternal domination on digraphs and orientations of graphs

Alice Joffard, Guillaume Bagan and Hamamache Kheddouci

Abstract: We study the eternal dominating number and the m-eternal dominating number on digraphs. We generalize known results on graphs to digraphs. We also consider the problem "oriented (m-)eternal domination", consisting in finding an orientation of a graph that minimizes its eternal dominating number. We prove that computing the oriented eternal dominating number is NP-hard and characterize the graphs for which the oriented m-eternal dominating number is 2. We also study these two parameters on trees, cycles, cliques, bicliques and different kinds of grids.

Paper 49:

FPT algorithms to recognize well covered graphs

Rafael Teixeira de Araújo, Sulamita Klein and Rudini Sampaio

Abstract: Given a graph G, let $vc(G)$ and $vc^+(G)$ be the sizes of a minimum and a maximum minimal vertex covers, respectively. We say that G is well covered if $vc(G) = vc^+(G)$ (that is, all minimal vertex covers have the same size). Deciding if a graph is well covered is coNP-complete.In this paper, we obtain $O^*(2^{vc})$-time and $O^*(1.4656^{vc^+})$-time FPT algorithms to decide well coveredness, parameterized by $vc(G)$ e $vc^+(G)$, respectively, improving results of 2015 by Boria et al.We also obtain an FPT algorithm parameterized by $\alpha(G) = n - vc(G)$ for d-degenerate graphs, which include bounded genus graphs (as planar graphs) and graphs with bounded maximum degree.Finally, we use the primeval decomposition technique to obtain a linear time algorithm for extended P_4-laden graphs and $(q, q-4)$-graphs, which is FPT parameterized by q, improving results of 2013 by Klein et al.

Paper 50:

A Tutte's Perfect Matching Theorem for vertex colored graphs

Martín Matamala

Abstract: A classical result in Graph Theory is Tutte's Perfect Matching Theorem characterizing graphs admitting a perfect matching.

We present a generalization of this result to triples (V, E, c), where (V, E) is a graph and c is a function from V to $\mathbb{N}$. We call such triples *(vertex) colored graphs*. Tutte's Theorem will be the special case when every edge $uv \in E$ is *monochromatic*, that is, when $c(u) = c(v)$.

We define a *perfect matching*(p.m.) of a colored graph (V, E, c) to be a function m from E to the set of natural numbers s.t., for each $v \in V$, $\{e \in E : v \in e, m(e) = c(v)\}$ is a singleton.

We prove that a colored graph (V, E, c) has a p.m. if and only if for each $S \subseteq V$ and each $F \subseteq E$ of non-monochromatic edges, the graph $(V, E) \setminus (S \cup F)$ has at most $|S \cup F|$ components (W, J) with $|W|$ odd and such that each non-monochromatic edge incident to some vertex in W belongs to F.

Paper 51:

Spanning trees with few branch vertices

Louis Debiasio and Allan Lo

Abstract: A branch vertex in a tree is a vertex of degree at least three. We prove that, for all $s \geq 1$, every connected graph on n vertices with minimum degree at least $(\frac{1}{s+3} + o(1))n$ contains a spanning tree having at most s branch vertices. Asymptotically, this is best possible and solves a problem of Flandrin, Kaiser, Kužel, Li and Ryjáček, which was originally motivated by an optimization problem in the design of optical networks.

Paper 52:

Every planar graph of maximum degree 8 is totally 10-choosable

Marthe Bonamy, Théo Pierron and Eric Sopena

Abstract: Total coloring is a variant of vertex/edge coloring where both vertices and edges are to be colored. In this work, we investigate the list version of this problem. A graph is totally k-choosable if for any list assignment of k colors to each vertex and each edge, we can extract a proper total coloring. In this setting, a graph of maximum degree Delta needs at least Delta+1 colors. For a planar graph, Borodin proved in 1989 that Delta+2 colors suffice when Delta is at least 9. Similar results hold for edge-choosability with one color less. Recently, the first author proved that for edge-choosability, Delta+1 colors are sufficient when Delta is only 8. We explain here how to extend both results to the setting of total choosability for planar graphs of maximum degree 8.

Paper 54:

Graph coloring reduction methods and application to McDiarmid-Reed's Conjecture

Jean-Christophe Godin and Olivier Togni

Abstract: We define general reduction tools for (a,b)-coloring of graphs where $2 \leq a/b \leq 3$. The utility of these tools is exemplified on finite triangle-free induced subgraphs of the triangular lattice. Computations on millions of such graphs generated randomly show that our tools allow to find (in linear time) a $(9,4)$-coloring for each of them.

Paper 55:

Online graph coloring with bichromatic exchanges

Marc Heinrich and Sylvain Gravier

Abstract: Greedy algorithms for the graph coloring problem require a large number of colors, even for very simple classes of graphs. For example, Gyárfás and Lehel proved that any greedy algorithm coloring trees requires $\Omega(\log n)$ colors in the worst case. We consider a variation of the First-fit algorithm in which the algorithm is allowed to make modifications to previously colored vertices by performing a polynomial number of local bichromatic exchanges. We show that such algorithms can be used to find in polynomial time an optimal coloring in the case of bipartite graphs, chordal graphs and outerplanar graphs. We also show that it can find in polynomial time a coloring of general planar graphs with $O(\log \Delta)$ colors, where Δ is the maximum degree of the graph. The question of whether planar graphs can be colored by a polynomial time online algorithm with bichromatic exchanges using only a constant number of colors is still open.

Paper 56:

Genus and duality index of a hypermap

Daniel Pinto

Abstract: Topologically, a *hypermap* is a cellular embedding of a connected hypergraph into a closed connected surface. A more algebraic approach can also be followed. For instance, an oriented regular hypermap can be regarded as a triple $\mathcal{H} = (\Delta^+/H, x, y)$, with Δ^+ being the subgroup of index 2 in the triangle group Δ, and $\Delta^+/H = \langle x, y\rangle$ being the monodromy group of the oriented regular hypermap. The duality group of $\mathcal{H}$ is defined as the the minimal subgroup $D(\mathcal{H}) \trianglelefteq Mon(\mathcal{H})$ such that $\mathcal{H}/D(\mathcal{H})$ is a self-dual hypermap (a hypermap isomorphic to its dual). In this talk, we will try to show some relationships between the duality index (the order of $D(\mathcal{H})$) and the genus of a hypermap.

Paper 57:

Infinite n-ordered Graphs and Independent Distinguishing Sets

Christopher Duffy and Jeannette Janssen

Abstract: A graph G is n-ordered if its vertices can be enumerated so each vertex has no more than n neighbours appearing earlier in the enumeration. Consider the following process for generating an infinite n-ordered graph. Let G_0 be a finite n-ordered graph. Form G_{I+1} from G_i as follows: For each $S \subseteq V(G_i)$ of cardinality at most n, add a new vertex adjacent to every vertex in S. Taking the limit of this process gives a n-ordered infinite graph with countably many vertices. This construction method is reminiscent of the deterministic construction of the Rado graph. In this work we use universal adjacency properties to study the class of all infinite graphs that admit such a construction. For these graphs, we provide a probabilistic construction and also show that these universal adjacency properties imply the existence of independent distinguishing sets.

Paper 58:

Total colorings of graphs with minimum sum of colors; existence of T-strong graphs and trees.

Grzegorz Kubicki and Ewa Kubicka

Abstract:

The total chromatic sum of a graph is the minimum sum of colors (natural numbers) taken over all proper colorings of vertices and edges of a graph. We provide infinite families of graphs for which the minimum number of colors to achieve the total chromatic sum is larger than the total chromatic number and discuss two conjectures about total colorings of graphs and trees.

Paper 59:

Characterization of forbidden subgraphs for bounded star chromatic number

Ilkyoo Choi, Ringi Kim and Boram Park

Abstract: A proper coloring of a graph is a partition of its vertex set into independent sets. In 1973, Grünbaum suggested the concept of proper colorings that also forbid bicolored subgraphs, but no specific name was given. We revive this notion by defining an H-*avoiding coloring* to be a proper coloring that forbids a bicolored subgraph H. Examples are 2-distance coloring and star coloring, which forbids a bicolored P_3 and P_4, respectively. When considering the class $\mathcal{C}$ of graphs with no F-induced subgraph, it is known that graphs in $\mathcal{C}$ have bounded chromatic number if and only if F is a subgraph of K_2. We study this phenomena for the class of graphs with no F-subgraph for H-avoiding coloring. We completely characterize all graphs F for a large class of graphs H. As corollaries, we characterize all graphs F where the class of graphs with no F-subgraph has bounded star chromatic number and also acyclic chromatic number.

Paper 60:

Constructing set systems from graph alphabets

Cristina Martinez Ramirez and Alberto Besana

Abstract: We construct an algebraic equivalence between set systems with a given alphabet graph G and constant dimension codes (CDC) over finite fields. Moreover, we see that set systems generalise $t-$designs and groups divisible designs. Furthermore in the context of secret sharing schemes, we construct 2-designs from the projective line.

Paper 61:

Scaling matrices and counting the perfect matchings in graphs

Fanny Dufossé, Kamer Kaya, Ioannis Panagiotas and Bora Uçar

Abstract: We investigate efficient randomized methods for approximating the number of perfect matchings in bipartite graphs and general graphs. Our approach is based on assigning probabilities to edges. We show an unbiased estimator and bound its second moment. We also present practical experiments.

Paper 62:

Edge correlations in random regular hypergraphs and applications to subgraph testing

Alberto Espuny Díaz, Felix Joos, Daniela Kühn and Deryk Osthus

Abstract: Compared to the classical binomial random (hyper)graph model, the study of random regular hypergraphs is made more challenging due to correlations between the occurrence of different edges. We develop an edge-switching technique for hypergraphs which allows us to show that these correlations are limited for a large range of densities. This extends some previous results of Kim, Sudakov and Vu for graphs. From our results we deduce several corollaries on subgraph counts in random d-regular hypergraphs. We also prove a conjecture of Dudek, Frieze, Ruciński and Šileikis on the threshold for the existence of an ℓ-overlapping Hamilton cycle in a random d-regular r-graph. Moreover, we apply our results to prove bounds on the query complexity of testing subgraph-freeness. In the general graphs model, this problem was first studied by Alon, Kaufman, Krivelevich and Ron, who obtained several bounds on the query complexity of testing triangle-freeness.

Paper 63:

Vertex partitions of (C_3, C_4, C_6)-free planar graphs

François Dross and Pascal Ochem

Abstract: A graph is (k_1, k_2)-colorable if its vertex set can be partitioned into two sets, one inducing a graph with maximum degree at most k_1 and one inducing a graph with maximum degree at most k_2. We show that every (C_3, C_4, C_6)-free planar graph is $(0, 6)$-colorable. We also show that deciding whether a (C_3, C_4, C_6)-free planar graph is $(0, 3)$-colorable is an NP-complete problem.

Paper 64:

Disjoint maximal independent sets in graphs and hypergraphs

Fatma Kaci and Paul Dorbec

Abstract: The existence of disjoint maximal independent sets (*disjoint MIS*) in graphs was introduced by C. Berge (unpublished; see [**?**] and [**?**]) and independently C. Payan [**?**]. The study of disjoint MIS was generalized to hypergraphs by Acharya in [**?**].In this paper we continue these studies. In particular, we prove the existence of disjoint MIS in a connected graph G or in its complement $\overline{G}$ whenever G is of diameter larger than two or G is k-colorable with $k \leq 4$.

Paper 66:

Embedding trees of bounded degree in dense graphs

Matias Pavez Signe, Maya Stein and Guido Besomi

Abstract: We conjecture that every n-vertex graph of minimum degree at least $\frac{k}{2}$ and maximum degree at least $2k$ contains all trees with k edges as subgraphs. We prove an approximated version of this conjecture for trees of bounded degree for dense graphs.

Our work also has implications on the Erdős–Sós conjecture and the $\frac{2}{3}$-conjecture. We prove an approximated version of both conjectures for trees of bounded degree and dense host graphs.

Paper 67:

Color Patterns by Dynamic H-walks

Germán Benítez-Bobadilla, Hortensia Galeana-Sánchez and César Hernández-Cruz

Abstract: Let H be a digraph possibly with loops, let D be a multidigraph, and let $c : A(D) \to V(H)$ be a coloring of the arcs of D with the vertices of H. A sequence $W = (x_0, x_1, \ldots, x_n)$ in D, is a dynamic H-walk if for each $i \in \{0, \ldots, n-2\}$ there exist f_i and f_{i+1} such that f_i is an arc from x_i to x_{i+1}, f_{i+1} is an arc from x_{i+1} to x_{i+2}, and $(c(f_i), c(f_{i+1}))$ is an arc of H. For $u, v \in V(D)$, we say that u reaches v by a dynamic H-walk if there exists a dynamic H-walk from u to v in D. A subset $K \subseteq V(D)$ is a dynamic H-kernel of D if every vertex in $V(D) - K$ reaches some vertex in K by a dynamic H-walk, and no vertex in K can be reached by another vertex in K by a dynamic H-walk in D. Let D_3 be the family of digraphs H such that for every H-colored digraph D, D has a dynamic H-kernel. In this talk, we provide a characterization of D_3.

Paper 68:

Recognizing minimally tough graphs

Kitti Varga, Gyula Y. Katona and István Kovács

Abstract: Let t be a positive real number. A graph is called t-tough, if the removal of any cutset S leaves at most $|S|/t$ components. The toughness of a graph is the largest t for which the graph is t-tough. A graph is minimally t-tough, if the toughness of the graph is t and the deletion of any edge from the graph decreases the toughness. The complexity class DP is the set of all languages that can be expressed as the intersection of a language in NP and a language in coNP. We proved that recognizing minimally t-tough graphs is DP-complete for any positive integer t and for any positive rational number $t \leq 1$. We also investigate the minimum degree and the recognizability of minimally t-tough graphs in the class of chordal graphs, split graphs, claw-free graphs and $2K_2$-free graphs.

Paper 69:

Decomposability of graphs into subgraphs fulfilling the 1-2-3 Conjecture

Jakub Przybyło and Julien Bensmail

Abstract: The well-known 1-2-3 Conjecture asserts that the edges of every graph without isolated edges can be weighted with 1, 2 and 3 so that adjacent vertices receive distinct weighted degrees. This is open in general. We prove that every d-regular graph, $d \geq 2$, can be decomposed into at most 2 subgraphs (without isolated edges) fulfilling the 1-2-3 Conjecture if $d \notin \{10, 11, 12, 13, 15, 17\}$, and into at most 3 such subgraphs in the remaining cases. Additionally, we prove that in general every graph without isolated edges can be decomposed into at most 24 subgraphs fulfilling the 1-2-3 Conjecture, improving the previously best upper bound of 40. Both results are partly based on applications of the Lovász Local Lemma.

Paper 70:

The Eccentricity Connectivity Index of Certain Edge-Gluing Graphs

Nabeel Arif and Ahmed Salih

Abstract: The eccentric connectivity index denoted by ε^c is a novel distance-based molecular structure descriptor. It is defined as $\varepsilon^c(G) = \sum_{v \in V(G)} ecc\ v\ dv$ where $ecc\ v$ eccentricity of v and dv is degree of vertex v. In this paper, we computed the eccentricity connectivity index of certain graphs such as cycle and complete graphs and then computed their edge-gluing graphs.

Paper 71:

Discrete Morse theory for the collapsibility of supremum sections

Balthazar Bauer and Lucas Isenmann

Abstract: The Dushnik-Miller dimension of a poset $\leq$ is the minimal number d of linear extensions $\leq_1, \dots, \leq_d$ of $\leq$ such that $\leq$ is the intersection of $\leq_1, \dots, \leq_d$. Supremum sections are simplicial complexes introduced by Scarf and are linked to the Dushnik-Miller as follows: the inclusion poset of a simplicial complex is of Dushnik-Miller dimension at most d if and only if it is included in a supremum section coming from a representation of dimension d. Collapsibility is a topoligical property of simplicial complexes which has been introduced by Whitehead and which resembles to shellability. While Ossona de Mendez proved that a particular type of supremum sections are shellable, we show in this article that supremum sections are in general collapsible thanks to the discrete Morse theory developped by Forman.

Paper 73:

Spanning trees of dense digraphs

Richard Mycroft and Tássio Naia

Abstract: An oriented tree T of order n is *unavoidable* if every tournament of the same order contains a copy of T. We find a sufficient condition for T to be unavoidable, and use this to prove that almost all labelled oriented trees are unavoidable. This settles a 28-year old conjecture of Bender and Wormald, and yields a partial result for a conjecture of Havet and Thomassé. Moreover, we prove that for all $C > 0$ every tournament of order $n + o(n)$ contains every oriented tree T of order n and maximum total degree $\Delta(T) \leq (\log n)^C$, improving a result of Kühn, Mycroft and Osthus. We discuss a related question and some work in progress.

Paper 74:

On conservative graphs and Skolem systems

Ilan Goldfeder and Joaquín Tey

Abstract: The *conservative number* of a graph G is the minimum positive integer M, such that G admits an orientation and a labeling of its edges by distinct integers in $[1, M]$, such that at each vertex of degree at least three, the sum of the labels on the in-coming edges is equal to the sum of the labels on the out-going edges. A graph G is *conservative* if $M = |E(G)|$. A *Skolem system* is a generalization of the known Skolem and hooked Skolem sequences.In this talk we will show, by means of Skolem systems, that the conservative number of a galaxy (a disjoint union of stars) of size M is M for $M \equiv 0, 3 \pmod 4$, and $M + 1$ otherwise.

Paper 75:

List strong edge coloring of a $(2, 3)$-bipartite graph

Sungsik Kang and Boram Park

Abstract: A strong edge coloring of a graph is a proper edge coloring such that each color class is an induced matching. The strong chromatic index $\chi'_s(G)$ of a graph G is the minimum number of colors for G to have a strong edge coloring. A bipartite graph is called an (a, b)-bipartite graph if one part has maximum degree at most a and the other part has maximum degree b. Brualdi and Quinn Massey (1993) conjectured that for a (a, b)-bipartite graph G, $\chi'_s(G) \leq ab$, as a refinement of the conjecture by Faudree, Gyárfás, Schelp, Tuza (1990). The conjecture holds for $a = 2$ and $a = 3$, by Naprasit (2014) and Huang, Yu, Zhou (2017). In this talk, we study list strong edge coloring, and denote the list strong chromatic index by $ch'_s(G)$. We show that for a (2,3)-bipartite graph G, $ch'_s(G) \leq 6$. From a relation to incidence coloring, this is also a generalization of a result by Benmedjdoub et. al. (2017), on incidence 6-choosability of Hamiltonian cubic graph.

Paper 76:

Connected greedy colouring in claw-free graphs

Ngoc Khang Le and Nicolas Trotignon

Abstract: An ordering of the vertices of a graph is *connected* if every vertex (but the first) has a neighbor among its predecessors. The greedy colouring algorithm of a graph with a connected order consists in taking the vertices in order, and assigning to each vertex the smallest available colour. A graph G is *good* if for every connected induced subgraph H of G and for every connected order $\mathcal{O}$ of H, the greedy algorithm gives H an optimal colouring. We give the characterization of good claw-free graphs in terms of minimal forbidden induced subgraphs.

Paper 77:

Chains and anti-chains of length four in partially ordered sets

Adrian Binding and Jan Volec

Abstract: We show that the minimum density of homogeneous subsets (chains or anti-chains) of size four in partially ordered sets (posets) is asymptotically 1/27, which is known to be best possible. This verifies the first non-trivial case of a question of Samotij and Sudakov.Moreover, we obtain a stability version of this result stating that any large poset with a density of homogeneous subsets of almost 1/27 is close to either the union of three linear orders of roughly equal size, or, the ordering of three sets of equal size, with no relations inside the sets. The main ingredient used in the proof is the framework of flag algebras. Our work extends an earlier result of Balogh et al. on the analogous question for monotone subsequences of length four in permutations. The main difficulty of our generalization was to fully understand the set of all the extremal and nearly extremal constraints that a flag algebraic proof must respect, which ismore complex in the poset setting.

Paper 78:

Balanceable graphs

Yair Caro, Adriana Hansberg and Amanda Montejano

Abstract: Given a graph G and a 2-coloring $f : E(K_n) \to \{red, blue\}$, we say that f induces a *balanced* copy of G if there is a copy of G in K_n which, under coloring f, has $\lceil e(G)/2 \rceil$ red edges and $\lfloor e(G)/2 \rfloor$ blue edges or vice versa. Graphs G for which, for sufficiently large n, every coloring $f : E(K_n) \to \{red, blue\}$ with sufficiently many red and blue edges induces a balanced copy of G are called *balanceable*. In this work, we present a characterization of balanceable graphs, and analyze the balanceability of certain graph families as well as the extremal structures of the colorings that prevent to find the desired balanced graph.

Paper 80:

Power domination on triangular grids

Valentin Gledel, Prosenjit Bose, Claire Pennarun and Sander Verdonschot

Abstract: The concept of *power domination* emerged from the problem of monitoring electrical systems. Given a graph G and a set $S \subseteq V(G)$, a set M of monitored vertices is built as follows: at first, M contains only the vertices of S and their direct neighbors, and then each time a vertex in M has exactly one neighbor not in M, this neighbor is added to M. The *power domination number* of a graph G is the minimum size of a set S such that this process ends up with the set M containing every vertex of G.We show that the power domination number of a triangular grid T_k with triangular-shaped border of length $k-1$ is $\lceil k/4 \rceil$, and the one of a triangular grid H_k with hexagonal-shaped border of length $k-1$ is $\lceil k/3 \rceil$.

Paper 81:

Simultaneous Dominating Sets for Spanning Tree Factorings

Sebastian Johann, Sven Krumke and Manuel Streicher

Abstract: A factoring $\mathcal{F}$ is a set of graphs on the same vertex set V. A subset $S \subseteq V$ is a simultaneous dominating set if for every $F \in \mathcal{F}$ each vertex not in S is adjacent to a vertex in S, i.e., the set S is simultaneously a dominating set in every graph in the factoring $\mathcal{F}$. We call $\mathcal{F}$ a spanning tree factoring if it contains all spanning trees of a connected graph G. We consider the problem of finding a minimum size simultaneous dominating set for spanning tree factorings. We show that this problem is NP-complete and present a way to solve it in polynomial time on special graph classes like bipartite or chordal graphs.

Paper 82:

On essentially 4-edge-connected cubic bricks

Nishad Kothari, Marcelo de Carvalho, Charles Little and Claudio Lucchesi

Abstract: Lovász (1987) proved that every matching covered graph may be uniquely decomposed into a list of bricks (nonbipartite) and braces (bipartite).Carvalho, Lucchesi and Murty (2002) proved a conjecture of Lovász which states that every brick G, distinct from K_4,the triangular prism $\overline{C_6}$ and the Petersen graph, has a b-invariant edge e — that is, an edge e such that$G-e$ is a matching covered graph with exactly one brick.A cubic graph is essentially 4-edge-connected if it is 3-edge-connected and ifthe only 3-cuts are the trivial ones.A brick G is near-bipartite if it has a pair of edges $\{e,f\}$ such that $G-e-f$ is bipartite matching covered;for instance, K_4 and $\overline{C_6}$.We prove that every essentially 4-edge-connected cubic graph G is either a brick or a brace;furthermore, if G is a brick that is not near-bipartite and is not the Petersen graph,then G has at least $\frac{|V(G)|}{2}$ b-invariant edges.

Paper 83:

A linear time $\frac{8}{3}$-approximation for r-star guards in simple orthogonal art galleries

Tamás Róbert Mezei

Abstract: We study the problem of covering simple orthogonal art galleries with rectangular stars. The problem has been shown to be polynomial [?], but to our knowledge, the exponent of the running time is still in the double digits. A linear-time 3-approximation algorithm using a partitioning into staircase shaped regions has been discovered by [?]. This is a follow-up paper to our recent theoretical result [?] linking point guards to horizontal mobile guards and vertical mobile guards (vision is restricted to rectangular vision). The result of this paper is that the algorithm implicitly described by our theoretical result can in fact be run in linear time. The novelty of the approach is the sparse representation of the pixelation graph of simple orthogonal polygons and the heavy reliance on so-called horizontal and vertical R-trees. After translating the problem into graph theory, geometrical insight is barely needed to verify the correctness of the algorithm.

Paper 84:

On Cayley graphs of algebraic structures

Didier Caucal

Abstract: We present simple graph-theoretic characterizations of Cayley graphs for left-cancellative and cancellative monoids, groups, left-quasigroups and quasigroups. We show that these characterizations are effective for the suffix graphs of word rewriting systems.

Paper 85:

Cycles Containing All the Odd-Degree Vertices

Kathie Cameron

Abstract: I prove that if G is a finite simple graph in which no two even-degree vertices are adjacent, and if e is an edge of G, then the number of cycles containing e and all the odd-degree vertices is even. Andrew Thomason proved this when there are no even-degree vertices using his elegant lollipop method. Thomason's Theorem itself generalizes Smith's Theorem, which is the instance in which all vertices have degree 3.This work was inspired by a recent result of Carsten Thomassen, who proved that in a graph in which no two even-degree vertices are adjacent, if there is one cycle containing all the odd-degree vertices, then there is another.

Paper 86:

Rainbow vertex coloring bipartite graphs and chordal graphs

Pinar Heggernes, Davis Issac, Juho Lauri, Paloma de Lima and Erik Jan van Leeuwen

Abstract: Given a vertex colored graph, a path is called a rainbow vertex path if all its internal vertices have distinct colors. A graph G is rainbow vertex-connected if there is a rainbow vertex path between every pair of its vertices and it is strong rainbow vertex-connected if there is a rainbow vertex shortest path between every pair of vertices of G. We study the problem of deciding whether the vertices of a given graph can be colored with at most k colors so that the graph becomes (strong) rainbow vertex-connected. Although edge colorings have been studied extensively under similar constraints, there are significantly fewer results on the vertex version that we consider. We show that the problem and its strong variant are NP-complete and hard to approximate on bipartite graphs and on chordal graphs, even on bipartite apex graphs and on split graphs. On the positive side,

we show polynomial time results on bipartite permutation graphs, interval graphs, and block graphs.

Paper 87:

Graph searches and geometric convexities in graphs

Feodor Dragan, Michel Habib and Lalla Mouatadid

Abstract: We discuss the relationship between graph searches and graph convexities. Nearly every graph search produces a convex geometry, i.e. every set of visited vertices is convex for some convex geometry. Many convex geometries have been defined on graphs using an interval definition: geodesic, monophonic... . We recall that the Lexicographic Breadth First Search (LexBFS) captures these convex geometries on many graph classes and we finish with some new properties on AT-free graphs.

Paper 88:

Cycle creating paths

Dániel Soltész and István Kovács

Abstract: We say that two paths on the same vertex set create a k-cycle if the union of the two paths (the union of their edges) contains a k-cycle. Let the maximal number of pairwise k-cycle creating paths on n vertices be $H(n, k)$. We study $H(n, k)$ for fixed k and large n. The behavior of $H(n, k)$ when k is even is very different than when k is odd. The only known exact value of $H(n, k)$ is when $k = 3$. In this talk we present the known bounds involving $H(n, k)$ and we discuss the connection between $H(n, 3)$ and the colliding permutations conjecture, and the connection between $H(n, 4)$ and the reversing permutations conjecture.

Paper 89:

Structural characterizations for polynomially-time recognizable (r, l)-well covered graphs.

Sancrey Rodrigues Alves, Fernanda Couto, Luerbio Faria, Sylvain Gravier, Sulamita Klein and Uéverton Dos Santos Souza

Abstract: An (r, l)-partition of a graph G is a partition of its vertex set into r independent sets and l cliques. A graph is (r, l) if it admits an (r, l)-partition. The dichotomy P versus NP-complete for recognizing (r, l)-graphs is well-known[2]: the problem is in P if max$r, l \leq 2$, and NPcomplete otherwise. Well-covered graphs are graphs in which every maximal independent set is also maximum. The problem of recognizing a well-covered graph was proved to be coNPcomplete[4,10]. A graph G is said (r, l)-well-covered if G is both (r, l) and well-covered. In (r, l)-well-covered ($(r, l)wcg$) problem, we are given an undirected graph $G = (V, E)$, and we are asked to determine whether G is a (r, l) and a well-covered graph. Alves et al. [1] proved that (r, l)-well-covered problem is polynomial when $r \leq 1$ and $l \leq 2$ or $r = 2$ and $l = 0$, and hard otherwise. In this paper we give structural characterizations to each of the following six subclasses: $(0, 1)wcg$, $(0, 2)wcg$, $(1, 0)wcg$, $(1, 1)wcg$, $(1, 2)wcg$, and $(2, 0)wcg$.

Paper 90:

Family of graphs without 2-community structure

Clément Dallard, Cristina Bazgan, Janka Chlebikova and Thomas Pontoizeau

Abstract: In the context of community structure detection, we study the existence of a partition of the vertex set of a graph into two parts such that each part is a community, namely a 2-*community structure*.We use the definition of a community where each vertex of the graph has a larger proportion of neighbors in its community than in the other community.There are few results about this problem, and it was not known if there exist graphs without 2-community structure, except stars.In this paper, we present a class

of graphs without 2-community structure and leave some interesting open questions about the problem.

Paper 91:

Equitable Coloring of subclasses of Chordal Graphs

Guilherme de Castro Mendes Gomes, Carlos Vinicius Lima and Vinícius F. Dos Santos

Abstract: A graph on n vertices is equitably k-colorable if it is k-colorable and every color is used either $\lfloor n/k$ or $\lceil n/k$ times. Such a problem appears to be considerably harder than vertex coloring, being NPc even for cographs and interval graphs. In this work, we prove that it is $W[1]$-$Hard$ for block graphs when parameterized by the number of colors; and for $K_{1,4}$-free interval graphs when parameterized by treewidth, number of colors and maximum degree, generalizing a result by Fellows et al. (2014) through a much simpler reduction. Finally, using a previous result due to de Werra (1985), we establish a dichotomy for the complexity of equitable coloring of chordal graphs based on the size of the greatest induced star.

Paper 92:

Bounding χ by a fraction of Δ for graphs without large cliques

Marthe Bonamy, Tom Kelly, Peter Nelson and Luke Postle

Abstract: In this talk, I will present new results on coloring graphs of bounded maximum degree Δ with no cliques of size greater than ω. In the 90s, Johansson proved that $\chi = O(\Delta/\ln(\Delta))$ and $\chi = O(\Delta \ln(\ln(\Delta))/\ln(\Delta))$ if $\omega = 2$ and if ω is fixed, respectively. Reed's Conjecture states that $\chi \leq \lceil(\Delta + 1 + \omega)/2\rceil$. It is natural to ask if Reed's conjectured bound can be improved if $\omega = o(\Delta)$ when Johansson's results do not apply. We answer this question by proving that

$$\chi = O\left(\Delta\sqrt{\frac{\ln(\omega)}{\ln(\Delta)}}\right).$$

For sufficiently large Δ, our result implies that if $\omega^{(72c)^2} \leq \Delta$ then $\chi \leq \Delta/c$.

This bound actually holds for list-coloring and even correspondence-coloring (a.k.a. DP-coloring). In fact, we prove what we call a "local version" of it, which simultaneously implies our bound and the two aforementioned results of Johansson.

Paper 93:

Four bounds for the dichromatic number of a digraph

Narda Cordero-Michel and Hortensia Galeana-Sánchez

Abstract: For a digraph D, we define the *dichromatic number*, $\chi_A(D)$, of D as the minimum k for which D admits a k-coloring of its vertices such that each color class induces an acyclic subdigraph in D. This number is related to de chromatic number of an undirected graph as follows: Let G be a graph and let D be digraph obtained from G by replacing each edge uv of G by a pair of symmetric arcs, (u, v) and (v, u); an acyclic coloring of D is a proper coloring of G, since each pair of adjacent vertices in G belong to a common 2-cycle in D and thus they must have different colors.

Determine the dichromatic number of a digraph is a difficult task. In fact, the authors in [?] proved that the problem of deciding if a given digraph D has dichromatic number equal to 2 is NP-complete, this is even true when D is a tournament. Therefore, a more reasonable task is to give bounds for these number. In this talk we will give four of these bounds.

Paper 94:

An Erdős-Gallai type theorem for vertex colored graphs

Oscar Zamora Luna, Nika Salia and Casey Tompkins

Abstract: While investigating odd-cycle free hypergraphs, Győri and Lemons introduced a colored version of the classical theorem of Erdős and Gallai on P_k-free graphs. They proved that any graph G with a proper vertex coloring and no path of length $2k+1$ with endpoints of different colors has at most $2kn$ edges. We show that Erdős and Gallai's original sharp upper bound of kn holds for their problem as well. We also introduce a version of this problem for trees and present a generalization of the Erdős-Sós conjecture.

Paper 95:

A characterization of graphs with Dilworth number at most 3

Vaidy Sivaraman, Bart Litjens, Sven Polak and Bart Sevenster

Abstract: The forbidden induced subgraph characterization for the classes of graphs with Dilworth number at most 1 and 2 are known. We give the forbidden induced subgraph characterization for the class of graphs with Dilworth number at most 3. We conjecture that for any natural number k, every forbidden induced subgraph for the class of graphs with Dilworth number at most k has at most 3k+1 vertices, and verify this for k less than or equal to 7.

Paper 96:

Uniform Orderings for Generalised Colouring Numbers and Graph Classes with Bounded Expansion

Jan van den Heuvel and H.A. Kierstead

Abstract: The generalised colouring numbers were introduced by Kierstead and Yang as a generalisation of the usual colouring number, and have since found important theoretical and algorithmic applications. The definitions of these numbers involve a given distance and linear orderings of the vertices of the graphs. For different distances, the optimal orderings can be completely different. We show that it is possible to find a single uniform ordering that approximates (in a precisely prescribed way) all the generalised colouring numbers of that graph. These uniform orderings also provide a new characterisation of graph classes of bounded expansion, where for every class in the graph we need only find one uniform ordering.

Paper 97:

Graphs and 3-uniform linear hypergraphs with no 5-cycle

Ervin Gyori, Beka Ergemlidze, Abhishek Methuku and Nika Salia

Abstract: In this talk, we investigate graphs and 3-uniform linear hypergraphs not containing any copy of the cycle C_5 (in Berge sense).We study the maximum number of triangles in C_5-free graphs, first studied by Bollobás and the speaker, improved later by Alon and Shikhelman. We prove $\frac{1}{3\sqrt{3}}(1+o(1))n^{3/2} \le ex(n, K_3, C_5) \le \frac{1}{2\sqrt{2}}(1+o(1))n^{3/2}$. The number of hyperedges in C_5-free 3-uniform hypergraphs first was studied by Bollobás and the speaker too, and it was improved by Füredi an Özhahya. For C_{2k+1}-free hypergraphs, the extremal number was estimated by Lemons and the speaker. We study it in 3-uniform linear hypergraphs. Let $\mathbf{F}$ be a family of 3-uniform linear hypergraphs.The linear Turán number of $\mathbf{F}$ is the maximum possible number of edges in a 3-uniform linear hypergraph on n vertices which

contains no member of $\mathbf{F}$ as a subhypergraph. We asymptotically determine this Turán number for C_5.

Paper 98:

The price of connectivity for domination

Marthe Bonamy, Nicolas Bousquet, Tereza Klimosova and Paul Ouvrard

Abstract: The price of connectivity for dominating set in a graph G is the ratio between the minimum sizes of a connected dominating set and a dominating set of G. It is always at most three, and Zverovich characterized the class of graphs such that this ratio equals one. In this paper, we prove a conjecture of Camby and Schaudt by characterizing the class of graphs with price of connectivity at most two.

Paper 99:

Monochromatic cycle partitioning graphs of large minimum degree

Dániel Korándi, Richard Lang, Shoham Letzter and Alexey Pokrovskiy

Abstract: A classical theorem of Erdős, Gyárfás and Pyber states that any r-edge-colouring of the complete graph K_n admits a partition into $O(r^2 \log r)$ monochromatic cycles. Here we extend this result by showing that for large n any r-edge-colouring of a graph on n vertices with minimum degree $n/2 + 400r \log n$ admits a partition into $O(r^2)$ monochromatic cycles.

Paper 100:

Hamiltonian properties of 3-connected (claw,hourglass)-free graphs

Zdenek Ryjacek, Petr Vrana and Liming Xiong

Abstract: We consider sufficient conditions for hamiltonian properties, namely, the well-known forbidden subgraph conditions for hamiltonicity and Hamilton-connectedness and degree conditions for circumference and hamiltonicity in 3-connected claw-free graphs, and we show that these conditions can be substantially strengthened under an additional assumption that the graph under consideration is hourglass-free (where hourglass is the graph with degree sequence 4,2,2,2,2).

Paper 101:

Incidence coloring of some special classes of graphs

Mária Maceková, František Kardoš, Martina Mockovčiaková, Éric Sopena and Roman Soták

Abstract: An incidence in a graph G is a pair (v, e) where v is a vertex of G and e is an edge of G incident to v. Two incidences (v, e) and (u, f) are adjacent if at least one of the following holds: (i) $v = u$, (ii) $e = f$, or (iii) edge vu is from the set $\{e, f\}$. An incidence coloring of G is a coloring of its incidences assigning distinct colors to adjacent incidences and corresponding chromatic number is called the incidence chromatic number. In this talk we present some results on graphs regarding their maximum degree and maximum average degree. We show that the incidence chromatic number is at most $\Delta(G) + 2$ for any graph G with $\text{mad}(G) < 3$ and $\Delta(G) = 4$, and for any graph with $\text{mad}(G) < \frac{10}{3}$ and $\Delta(G) \geq 8$. We also improved the bound for planar graphs with $\Delta(G) = 6$ to $\Delta(G) + 4$ in general.

Paper 102:

On the End-Vertex Problem

Jesse Beisegel, Carolin Denkert, Ekkehard Köhler, Matjaž Krnc, Nevena Mitrović, Robert Scheffler and Martin Strehler

Abstract: For a given graph search algorithm and a graph G, a vertex v is said to be an end-vertex if there exists a corresponding search ordering of the vertices such that v is the last vertex in this ordering. It is known that the complexity of recognizing the end-vertices in general graphs is NP-hard for several search algorithms, such as Breadth First search, Depth First Search, and their lexicographic variants. This motivated the study of end-vertices with respect to some other search algorithms. In this work we consider the Maximum Cardinality Search (MCS) and the Maximum Neiborhood Search (MNS) and present the results concerning complexity of the end-vertex problem with respect to these search methods.

Paper 103:

Bounding the Number of Minimal Transversals in Tripartite 3-Uniform Hypergraphs

Alexandre Bazin, Laurent Beaudou, Giacomo Kahn and Kaveh Khoshkhah

Abstract: We bound the number of hypergraph transversals that arise in tripartite 3-uniform hypergraphs, a class commonly found in data mining and other applications. It is more than $c3.35^{(n/3)}$ and less than $3.45^{n/3}$.

Paper 104:

Online coloring of intersection graphs of disks, polygons and other convex shapes

Konstanty Junosza-Szaniawski, Patryk Mikos and Joanna Sokół

Abstract: We introduce an online coloring algorithms for intersection graphs of various geometrical shapes such as disks, parallelograms, triangles, general convex shapes. We consider intersection graphs of congruent geometrical shapes and we assume the ration between largest and smallest shape is bounded (say by a real number σ). The competitive ration of our algorithms is $O(\log \sigma)$. Our algorithm uses Hadwiger-Nelson type coloring of the plane dedicated for each shape.

Paper 105:

Domination problems in grid graphs

Alexandre Talon and Michael Rao

Abstract: We investigate the 2-domination number for grid graphs, that is the size of a smallest set D of vertices of the grid such that each vertex of the grid belongs to D or has at least two neighbours in D. We find the 2-domination number of any $n \times m$ grid. The proof relies on some dynamic programming algorithms, using transfer matrices in (min,+)-algebra. This confirms the results found by Lu and Xu, and Shhaeen et al. for $n \leq 4$ and correct the value of Shaheen et al. for $n = 5$. We apply the same method to solve the Roman domination problem on grids.

Paper 107:

The maximum number of P_l copies in P_k-free graphs

Ervin Győri, Nika Salia, Casey Tompkins and Oscar Zamora Luna

Abstract: Generalizing Turán's classical extremal problem, Alon and Shikhelman investigated the problem of maximizing the number of T copies in an H-free graph, for a pair of graphs T and H. Whereas Alon and Shikhelman were primarily interested in determining the order of magnitude for large classes of graphs H, we focus on the case when T and H are paths, where we find asymptotic and in some cases exact results. We also consider other structures like stars and the set of cycles of length at least k, where we derive asymptotically sharp estimates. Our results generalize well-known extremal theorems of Erdős and Gallai.

Paper 108:

The dimension of posets with excluded minors in cover graphs

Michał Seweryn

Abstract: A fan is a graph obtained from a path by adding an extra vertex adjacent to all vertices on the path. We give a qualitative structure theorem for graphs excluding a fan as a minor. This is inspired by a recent result by Ding that gives an approximate description of graphs excluding $K_{2,n}$ as a minor. Next, we use both characterizations to show that the dimension of a poset is bounded in terms of the size of a largest $K_{2,n}$ or a fan (graph) which is a minor of the cover graph. This is a step towards characterization of minor-closed graph classes such that posets with cover graphs from such a class has bounded dimension.

Paper 109:

Coloring and list coloring digraphs

Ararat Harutyunyan

Abstract: The dichromatic number $\vec{\chi}(D)$ of a digraph D is the least number k such that the vertex set of D can be partitioned into k parts each of which induces an acyclic subdigraph. Introduced by Neumann-Lara in 1982, this digraph invariant shares many properties with the usual chromatic number of graphs and can be seen as its natural analog. There has been a renewed interest in this parameter during the last few years. We give a survey of some of the recently obtained results, including results on the list version of the problem. We also discuss some ongoing work and open conjectures.

Paper 110:

Cut-Covering Decompositions for Connectivity Problems

Arash Haddadan, Alantha Newman and R. Ravi

Abstract: We study decompositions of graphs that cover small-cardinality cuts an even number of times, and we use these tools to design approximation algorithms for the traveling salesman problem (TSP) and the 2-edge-connected spanning multigraph problem (2EC) on restricted classes of weighted graphs. For example, Boyd, Iwata and Takazawa gave an algorithm to find a cycle cover that covers all 3- and 4-edge cuts in a bridgeless, cubic graph. We apply this to connectivity problems on *node-weighted*, 3-edge-connected, cubic graphs. To extend this approach to 2-edge-connected graphs, we present a procedure to decompose a solution for the subtour linear program into spanning, connected subgraphs that cover each 2-edge cut an even number of times, and we apply this to 2EC on subcubic, node-weighted graphs. Finally, we apply these decomposition tools to the problem of *uniform covers*, answering a question of Sebő.

Paper 111:

Perfect landmark sets in the ALT route planning algorithm

Michał Dębski, Konstanty Junosza-Szaniawski, Zbigniew Lonc and Michał Tuczyński

Abstract: A perfect landmark set is a set L of vertices such that every shortest path can be extended to a shortest path from a vertex in L to some other vertex. We denote the size of a minimum perfect landmark set in G by $mpls(G)$.

Landmark sets play a crucial role in the ALT algorithm that finds shortest paths in weighted graphs. For a fixed perfect landmark set L in a graph G, after some preprocessing using $O(|L||V(G)|)$ memory, it is possible to determine the distance between any two vertices in time $O(|L|)$. Therefore, it is desirable to find small perfect landmark sets. We show that determining $mpls(G)$ is NP-hard.

We also introduce the parameter $mpls^*(G)$ equal to the minimum of $mpls(H)$ over all weighted graphs H such that G is an isometric subgraph of H. Sometimes $mpls^*(G)$ is much smaller than $mpls(G)$ and a further improvement of performance of route planning can be obtained.

Paper 112:

Excluded Minors for Embeddings of Metric Graphs in ℓ_∞^n-Spaces

Samuel Fiorini, Tony Huynh, Gwenaël Joret and Carole Muller

Abstract: A metric graph is a pair (G, d), where $G = (V, E)$ is a graph and $d : E \to \mathbb{R}_{\geq 0}$ is a distance function on E. An isometric embedding of the metric graph (G, d) in $\ell_\infty^n = (\mathbb{R}^n, d_\infty)$ is a set of vectors $\{q_v\}_{v \in V} \subseteq \mathbb{R}^n$ such that $d_\infty(q_v, q_w) = d(vw)$ for all $vw \in E$. The graph parameter $f_\infty(G)$ is the least integer n such that there exists an isometric embedding of (G, d) in ℓ_∞^n for all distance functions d.The property $f_\infty(G) \leq n$ is closed under

taking minors. By the Graph Minor Theorem of Robertson and Seymour, there exists a finite list of excluded minors for the property $f_\infty(G) \leq n$.We present four graph families of unbounded f_∞-value and show that they are unavoidable in any graph with large f_∞-value. This can be viewed as an approximate characterization of graphs with large f_∞-value in the same vein as the grid theorem for graphs of large treewidth.

Paper 113:

Weighted independence ratio of geometric distance graphs

Thomas Bellitto, Christine Bachoc, Philippe Moustrou and Arnaud Pêcher

Abstract: In this work, we study the density of sets that do not contain two points at distance exactly one, especially in the case of norms induced by polytopes that tile the space by translation. In this case, Bachoc and Robins conjectured that the maximum density of a set avoiding distance 1 in $\mathbb{R}^n$ is $\frac{1}{2^n}$. We showed in previous work that this conjecture holds in dimension 2 and for certain infinite families of polytopes. This work presents an alternative approach which improves our results in dimension 3 and involves finding a weight distribution on the vertices of a graph that minimizes the ratio between the maximum weight of an independent vertex set and the total weight of the graph.

Paper 114:

On more variants of the Majority Problem

Paul-Elliot Anglès d'Auriac, Francis Maisonneuve, Vivien Maisonneuve, Emmanuel Preissmann and Myriam Preissmann

Abstract: The Majority problem can be formulated as follows. Given a set $\mathcal{B}$ of N balls, each of these colored either red or green, a colorblind player, who is unable to determine the color of a ball but can decide if two balls have the same color, wants to determine a ball of the majority color within a minimum number of comparisons. This problem has been first solved by Saks and Werman. We consider the variant where the goal of the player is to determine the color of every ball. Aigner gave bounds on the minimum number of questions, denoted $Q(N, p, \leq)$, that guarantees the determination of the colors of all balls in the case where there are at most p green balls in $\mathcal{B}$. We extended the results of Aigner on exact values of $Q(N, p, \leq)$. Similarly we define $Q(N, p, =)$ for the case where there are exactly p green balls in $\mathcal{B}$. We provide upper bounds for $Q(N, p, =)$, and exact values for the first two values of p. Our results lead to several new questions.

Paper 115:

Fibonacci numbers of graphs composition on some circulant graphs

Loiret Alejandría Dosal-Trujillo and Hortensia Galeana-Sánchez

Abstract: The Fibonacci number of a graph G, is the total number of independent vertex sets of G and it is denoted by $F(G)$. This concept was first defined by Prodinger and Tichy in 1982. A closely related concept is the independence polynomial of a graph, introduced in 1983 by Gutman and Harary. The problem of finding the Fibonacci number of a graph is an NP-complete problem. In 2017 we proved that for every two graphs G and H, the Fibonacci number of $G[H]$, the composition of G with H, can be obtained in terms of the independence polynomial of G and the Fibonacci number of H. A graph G is said to be vertex-transitive if the automorphisms group of

G acts transitively in its set of vertices. In this talk we will show how to calculate the Fibonacci number of $C_{n[r]}[H]$, the composition of a circulant graph of order n and consecutive jumps $(1, 2, \ldots, r)$ with a graph H, using the fact that $C_{n[r]}$ is a vertex-transitive graph.

Paper 116:

Strong duality and mutual transferability for mixed domination on strongly chordal graphs and cactus graphs

Kuan-Ting Chu, Wu-Hsiung Lin and Chiuyuan Chen

Abstract: Let $G = (V, E)$ be a graph and V be the disjoint union of F, B, and R.A mixed dominating set of G is a subset $D \subseteq V$ such that $R \subseteq D$and each vertex in $B - D$ is adjacent to some vertex in D. A mixed 2-stable set of G is a subset $S \subseteq B$ such that$S \cap N[R] = \emptyset$ and every two distinct vertices x and y in S have distance $d(x, y) > 2$.We prove that if G is strongly chordal, then $\alpha_{m,2}(G) = \gamma_m(G) - |R|$,where $\gamma_m(G)$ is the minimum cardinality of a mixed dominating set of $G$and $\alpha_{m,2}(G)$ is the maximum cardinality of a mixed 2-stable set of G.Let D_1 and D_2 be any mixed dominating sets of G with $|D_1| = |D_2|$.We also prove that if G is connected strongly chordal,then D_1 and D_2 are mutually transferable;and if G is a cactus graph, then adding one extra element can ensure thatD_1 and D_2 are mutually transferable.

Paper 118:

The swap Markov chain on bipartite degree sequences with bounded maximum degree is rapidly mixing

Peter L. Erdos, Tamas R. Mezei, Istvan Miklos and Daniel Soltesz

Abstract: In the last two decades the **swap** (switch) Markov chain approach was heavily used to sample realizations of graphic degree sequences. It is conjectured that this Markov chain is rapidly mixing on all sequences, however there are particulary few proven cases. Here we report two new results:(1) Let d be a bipartite graphical degree sequence, and let $\Delta = \max d$. Let M be the sum of the degrees on one class. If $2 \leq \Delta \leq \frac{1}{\sqrt{2}}\sqrt{M}$, then the swap Markov Chain on the realizations of d is rapidly mixing.(2) Let $\vec{d}$ be a directed degree sequence. Let M be the sum of the out-degrees. If

$$\max\{\max d_{out}, \max d_{in}\} < \sqrt{M/2-2},$$

then the swap Markov chain on this directed degree sequence is rapidly mixing.These results are germane to the recent results of Greenhill and Sfragara about rapidly mixing MCMC processes on simple and directed degree sequences.

Paper 119:

The sandwich conjecture of random regular graphs and more

Mikhail Isaev, Jane Gao and Brendan McKay

Abstract: The sandwich conjecture formulated in [Kim, Vu, Advances in Math., 2004] states that if min$d, n-d >$ log n, then the random d-regular graph on n vertices can asymptotically almost surely be "sandwiched" between $G(n, p1)$ and $G(n, p2)$ where probabilities $p1$ and $p2$ are both $(1+o(1))d/n$. They proved this conjecture for the range $logn < d < n^(1/3-o(1))$ with a defect in one side of sandwiching: a few edges from each

vertex should be deleted from the random regular graph to guarantee the containment. Recently, their result (one-sided containment) was improved by Dudek, Frieze, Rucinski and Sileikis to $d = o(n)$.

We prove the sandwich conjecture (with perfect containments on both sides) for all values of d such that $min(d, n-d) >> n/logn$. In this talk we also discuss extensions to random subgraphs of a given graph and, in particular, random regular bipartite graphs

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Paper 120:

Square-free graphs with no six-vertex induced path

Frédéric Maffray and T. Karthick

Abstract: We elucidate the structure of (P_6, C_4)-free graphs by showing that every such graph either has a clique cutset, or a universal vertex, or belongs to several special classes whose structure is completely characterized. Using these results we show that every such graph G has chromatic number at most $\lceil \frac{5}{4}\omega(G) \rceil$ and that this is the best possible bound. Another consequence is the existence of polynomial-time algorithms that compute the chromatic number and the stablity number of any graph in this class.

Paper 122:

Planar Steiner Orientation is NP-complete

Moritz Beck, Johannes Blum, Myroslav Kryven, Andre Löffler and Johannes Zink

Abstract: Many applications in graph theory are motivated by routing or flow problems. Among these problems is Steiner Orientation: given a mixed graph G (having directed and undirected edges) and a set T of k terminal pairs in G, is there an orientation of the undirected edges in G such that there is a directed path for every terminal pair in T? This problem was shown to be NP-complete by Arkin and Hassin and later W[1]-hard by Pilipczuk and Wahlström, parametrized by k. On the other hand, there is an XP algorithm by Cygan et al. and a polynomial time algorithm for graphs without directed edges by Hassin and Megiddo. Chitnis and Feldmann showed

W[1]-hardness of the problem for graphs of genus 1. We consider a further restriction to planar graphs and show NP-completeness.

Paper 123:

On weakly distinguishing graph polynomials

Johann Makowsky and Vsevolod Rakita

Abstract: A univariate graph polynomial $P(G;X)$ is weakly distinguishing if for almost all finite graphs G there is a finite graph H with $P(G;X) = P(H;X)$. We show that the clique polynomial and the independence polynomial are weakly distinguishing. Furthermore, we show that generating functions of induced subgraphs with property C are weakly distinguishing provided that C is of bounded tree-width. The same holds for the harmonious chromatic polynomial.

Paper 124:

Maximally Centralized Bipartite Networks

Zelealem Yilma, Matjaz Krnc, Jean-Sébastien Sereni and Riste Skrekovski

Abstract: Following up on the work by Everett, Sinclair, and Dankelmann [Some Centrality results new and old, J. Math. Sociology 28 (2004), 215–227], we study the problem of determining the most centralized networks among networks obtained via two-mode data. Specifically, we consider the closeness and eccentricity centralization measures on bipartite networks with fixed size partitions. We find that while there is a unique extremal configuration in the case of closeness centralization (as conjectured by Everett, Sinclair, and Dankelmann), there are multiple such configurations for eccentricity centralization. In all cases, maximizing the centrality of the central node takes precedence over minimizing the centrality of non-central nodes.

Paper 125:

Random colorings of bounded degree graphs

Michelle Delcourt, Guillem Perarnau and Luke Postle

Abstract: A well-known conjecture in graph coloring is that Glauber dynamics on the set of k-colorings of a graph G on n vertices with maximum degree Δ is rapidly mixing for $k \geq \Delta + 2$. In 1999 Vigoda showed rapid mixing time of a modified version of flip 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. 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 is easier to analyze than stopping-time-based metrics and we believe will have fruitful applications for bounding the mixing times of other Markov chains.

Paper 127:

Triangle-free projective-planar graphs with diameter two: domination and characterization

Dibyayan Chakraborty, Sandip Das, Srijit Mukherjee, Uma Kant Sahoo and Sagnik Sen

Abstract: MacGillivray and Seyffarth (J. Graph Theory 22 (1996)) proved that planar graphs with diameter two has domination number at most three and Goddard and Henning (J. Graph Theory 40 (2002)) proved that there is only one planar graph that attains the upper bound. In this article, we prove that the domination number of triangle-free projective-planar graphs with diameter two is at most three and there are exactly seven graphs that attains the upper bound. Interestingly, six of these seven graphs can be obtained from the famous Grötzsch graph, Wagner graph or Peterson graph by addition or deletion of (specific) vertices. We also generalize a result of

Plesník's from 1975 and characterize all triangle-free projective-planar graphs with diameter two. Our proof gives a forbidden minor characterization for this class of graphs.

Paper 128:

Decomposing a Graph into Shortest Paths with Bounded Eccentricity

Léo Planche, Etienne Birmele, Fabien De Montgolfier and Laurent Viennot

Abstract: We introduce the problem of hub-laminar decomposition which generalizes that of computing a shortest path with minimum eccentricity (MESP). Intuitively, it consists in decomposing a graph into several paths that collectively have small eccentricity and meet only near their extremities. We show that a graph having such a decomposition with long enough paths can be decomposed in polynomial time with approximated guaranties on the parameters of the decomposition. Moreover, such a decomposition with few paths allows to compute a compact representation of distances with additive distortion. The problem is related to computing an isometric cycle with minimum eccentricity (MEIC). We also show that having an isometric cycle with small eccentricity is related to the possibility of embedding the graph into a cycle with low distortion.

Paper 129:

On directed versions of the 1-2-3 Conjecture and the 1-2 Conjecture

Mariusz Wozniak

Abstract: Let $G = (V, E)$ be a graph. Given an integer k, a k-coloring (labeling) of G is a function $f : E \to \{1, 2, \dots, k\}$. The coloring f can be represented by substituting each edge e of G by a multiedge with multiplicity $f(e)$. The degree of x in the respective multigraph equals the sum of labels around a vertex x. The 1-2-3 Conjecture says that for graphs without isolated edges there exists a 3-coloring f such the the corresponding multigraph is locally irregular *i.e.* for each edge xy of G we have $\sigma(x) \neq \sigma(y)$ where $\sigma(x) = \sum_{e \ni x} f(e)$. The 1-2 Conjecture refers to the case when we also color the vertices.

During the talk we shall look at the directed versions of these problems.

Paper 130:

An automaton describing left burnable configurations in the sandpile model on the ladder graph ZxP_H

Henri Derycke

Abstract: The sandpile model is well defined for any finite graph.Jarai and Lyons approximated the behaviour on the bi-infinite ladder ZxP_H by a series of rectangles of height H and increasing width.This leads them to the concept of left burnable configurations as a subset of recurrent configurations.We are interested in automata recognizing column by column these configurations.Jarai and Lyons give an explicit automaton for the height $H = 2$ and have shown that there is an automaton for all H with rough bound $(2^H)^(2^H)$ over the number of states.Based on a bijection between the recurrent configurations and the spanning trees, I propose a rough upper bound on the number of states in $c^{(HlogH)}$.The algorithms linked to this

bound make it possible to produce the automata for the height $H = 3$ with 13 states and $H = 4$ with 76 states. In this construction, the automaton contains at least b^H states because a subset of these states is in bijection with separable permutations.

Paper 131:

Optimal General Matchings

Szymon Dudycz and Katarzyna Paluch

Abstract: Given a graph $G = (V, E)$ and for each vertex v a subset $B(v)$ of the set $\{0, 1, \ldots, d_G(v)\}$, where $d_G(v)$ denotes the degree of vertex v, a B-matching of G is any set $F \subseteq E$ such that $d_F(v) \in B(v)$ for each vertex v. The general matching problem asks the existence of a B-matching in a given graph. A set $B(v)$ is said to have a gap of length p if there exists a number $k \in B(v)$ such that $k+1, \ldots, k+p \notin B(v)$ and $k+p+1 \in B(v)$. Without any restrictions the general matching problem is NP-complete. However, if no set $B(v)$ contains a gap greater than 1, then the problem can be solved in polynomial time[**?**]. In this paper we consider a problem of finding maximum cardinality general matching.

We present the first polynomial time algorithm for the maximum B-matching for the case when no set $B(v)$ contains a gap greater than 1. This also yields the first pseudopolynomial algorithm for the weighted version of the problem.

Paper 132:

Star Saturation Number of Random Graphs

B. Tayfeh-Rezaie and A. Mohammadian

Abstract: For a given graph F, the F-saturation number of a graph G is the minimum number of edges in an edge-maximal F-free subgraph of G. Recently, the F-saturation number of the Erdős–Rényi random graph $bmslG(n,p)$ has been determined asymptotically for any complete graph F. In this talk, we give an asymptotic formula for the F-saturation number of $mslG(n,p)$ when F is a star graph.

Paper 133:

Some Bounds on the Energy of Signed Complete Bipartite Graphs

Sima Saadat Akhtar, Saeed Akbari and Yousef Bagheri

Abstract: A *signed graph* G^σ is a pair (G,σ), where G is a graph, and $\sigma : E(G) \longrightarrow \{-1,+1\}$ is a function. Assume that $m \leq n$ are two positive integers. Let

$$A = \left[\begin{array}{c|c} 0 & B \\ \hline B^t & 0 \end{array}\right]$$

is the adjacency matrix of $K^\sigma_{m,n}$. In this talk we show that for every sign function σ, $2\sqrt{mn} \leq E(K^\sigma_{m,n}) \leq 2m\sqrt{n}$, where $E(K^\sigma_{m,n})$ is the energy of $K^\sigma_{m,n}$. Also it is proved that the equality holds for the upper bound if there exists a Hadamard matrix of order n for which B is an m by n submatrix of H. Also if the equality holds, then every two distinct rows of B are orthogonal. We prove that for the lower bound the equality holds if and only if $K^\sigma_{m,n}$ is switching equivalent to $K_{m,n}$.

Paper 134:

Some Lower Bounds of the Energy of Graphs

Yousef Bagheri, Saeed Akbari, Sima Saadat Akhtar and Amir Hossein Ghodrati

Abstract: Let G be a simple graph with the vertex set $V(G)$ and with the adjacency matrix $A(G)$. The energy $E(G)$ of G is defined to be the sum of the absolute values of all eigenvalues of $A(G)$. Given a graph G, its line graph $L(G)$ is a graph such that each vertex of $L(G)$ represents an edge of G; and two vertices of $L(G)$ are adjacent if and only if their corresponding edges share a common endpoint in G. In this paper we show that for every regular graphs and also for every line graphs such that $\delta(G) \geq 3$ we have, $E(G) \geq \frac{2m}{n} + n - 1$. Also it was proved that for any bipartite graph G, $2\mu(G) \leqslant E(G)$ such that $\mu(G)$ is the matching number of G and equality holds if and only if G is the disjoint union of some complete bipartite graphs with perfect matchings and some isolated vertices. We generalize this result by showing that it holds for an arbitrary graph.

Paper 135:

On density of subgraphs of Cartesian products

Victor Chepoi, Arnaud Labourel and Sébastien Ratel

Abstract: In this paper, we introduce a notion of VC-dimension VC-dim(G) of a subgraph G of a Cartesian product, generalizing the classical Vapnik-Chervonenkis dimension of set-families (viewed as subgraphs of hypercubes). We then extend a results of Haussler, Littlestone and Warmuth about the density of subgraphs of hypercubes to subgraphs G of Cartesian products $G_1 \times \cdots \times G_m$ of connected graphs. Namely, we prove that if $G_1, \ldots, G_m$ belong to the class $\mathcal{G}(H)$ of all finite connected graphs not containing a given graph H as a minor, then for any subgraph G of $G_1 \times \cdots \times G_m$ the inequality $\frac{|E(G)|}{|V(G)|} \leq \mu(H)\text{VC-dim}(G)$ holds, where $\mu(H)$ is the density of the graphs from $\mathcal{G}(H)$.

Paper 136:

Distance Magic Labelings of Strongly Regular Graphs

Rinovia Simanjuntak and I Wayan Palton Anuwiksa

Abstract: A graph G on n vertices is said to be distance magic if there exists a bijection $f : V \rightarrow \{1, 2, \ldots, n\}$ and a constant k such that for any vertex x, $\sum_{y \in N(x)} f(y) = k$, where $N(x)$ is the set of all neighbours of x.

In this paper we utilize spectra of graphs to characterize strongly regular graphs admitting distance magic labelings and strongly regular graphs whose line graphs admitting distance magic labelings. In addition, we obtain necessary conditions for the existence of distance magic labeling of distance regular graphs of diameter 3.

Paper 137:

Distance Magic Labelings of Strongly Regular Graphs

Zeina Ghazo Hanna and Amine El Sahili

Abstract: We prove that a tournament T and its complement T contain the same number of oriented Hamiltonian paths (resp. cycles) of any given type, as a generalization of Rosenfeld's result proved for antidirected paths.

Index

CNRS

LIP

LIRIS

ENS DE LYON

GRANDLYON
la métropole

MILYON
UNIVERSITE DE LYON

20 ans ROADEF

UCBL Lyon 1

IDEX LYON
UNIVERSITÉ DE LYON