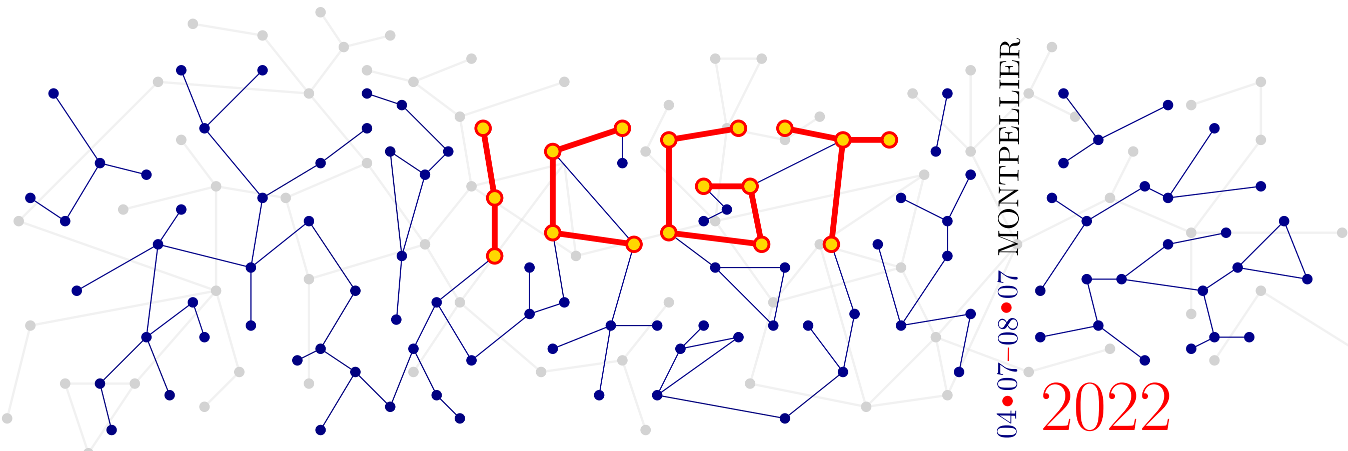
ICGT 2022

The 11th International Colloquium on Graph Theory and combinatorics

Schedule and list of abstracts



Organizing and Scientific Committee:

Stéphane Bessy
Marin Bougeret
Julie Cailler
Elena Demchenko
Virginie Fèche
Daniel Gonçalves
Hoang La
Mégane Miquel
Laure Morelle
Christophe Paul
Alexandre Pinlou
Evangelos Protopapas
Johann Rosain
Ignasi Sau (chair)
Giannos Stamoulis
Dimitrios M. Thilikos
Petru Valicov

Other members of the Scientific Committee:

Pierre Aboulker (ENS)
Marthe Bonamy (LABRI)
Pierre Charbit (IRIF)
Paul Dorbec (GREYC)
Frédéric Havet (INRIA Sophia-Antipolis)
Hamamache Kheddouci (LIRIS)
Eunjung Kim (LAMSADE)
Aurélie Lagoutte (LIMOS)
Mathieu Liedloff (LIFO)
Patrice Ossona de Mendez (CAMS)
András Sebö (G-SCOP)
Jean-Sébastien Sereni (ICube)
Olivier Togni (LIB)
Joanna Tomasik (LRI)
Nicolas Trotignon (LIP)
Mario Valencia-Pabon (LIPN)
Yann Vaxès (LIS)
Mathias Weller (LIGM)

Monday, July 4th (morning)

08:30 - 09:15	Registration			
09:15 - 09:30	Welcome			
09:30 - 10:30	Invited Talk (room: Amphi Dumontet, Bât 7): **Reinhard Diestel**: *Canonical graph decompositions via coverings*. Chair: Jørgen Bang-Jensen			
10:30 - 10:45	**Coffee break**			
	Room: 36.05 Session 1.1. Chair: Fedor Fomin	**Room**: 36.06 Session 1.2. Chair: Julien Baste	**Room**: 36.07 Session 1.3. Chair: Ervin Gyori	
10:45 - 11:15	Jan van den Heuvel and **Xinyi Xu**. *Towards Stahl's Conjecture: Multi-Colouring of Kneser Graphs* (paper 69)	Fedor V. Fomin, Petr A. Golovach, Ignasi Sau, **Giannos Stamoulis** and Dimitrios M. Thilikos. *Obstruction Set Constructibility of Minor-Closed Graph Classes* (paper 60)	**Valentin Bouquet**. *The bondage number of chordal graphs* (paper 59)	
11:15 - 11:45	Daniel Gonçalves, **Pascal Ochem** and Matthieu Rosenfeld. *Avoiding large squares in trees and planar graphs* (paper 75)	**Fernando Esteban Contreras-Mendoza** and César Hernández-Cruz. *Minimal obstructions for properties related to polarity on cograph superclasses* (paper 11)	Canguang Lin and **Annegret Wagler**. *Infinite families of non-superperfect graphs based on even antiholes* (paper 19)	
11:45 - 12:15	Mária Maceková, Roman Soták and **Zuzana Šárošiová**. *Interval vertex coloring* (paper 63)	Emmanouil Lardas, **Evangelos Protopapas**, Dimitrios M. Thilikos and Dimitris Zoros. *On Strict Brambles* (paper 47)	Milad Ahanjideh, **Tınaz Ekim** and Mehmet Akif Yıldız. *Maximum size of a triangle-free graph with bounded maximum degree and matching number* (paper 42)	
12:30 - 14:00	Lunch			

Monday, July 4th (afternoon)

14:00 - 15:00	Invited Talk (room: Amphi Dumontet, Bât 7) **Vida Dujmović**: *Stack and Queue layouts*. Chair: Daniel Gonçalves			
15:00 - 16:00	**Open problems session.** Chair: Frédéric Havet			
16:00 - 16:30	**Coffee break**			

	Room: 36.05 Session 2.1. Chair: Thomas Bellitto	**Room**: 36.06 Session 2.2. Chair: Petr Golovach	**Room**: 36.07 Session 2.3. Chair: Florent Foucaud	
16:30 - 17:00	Tapas Das, Tuomo Lehtilä, Soumen Nandi, Sagnik Sen and **D K Supraja**. *On radio k-coloring of the power of the infinite path* (paper 71)	**Narmina Baghirova**, Clément Dallard, Bernard Ries and David Schindl. *On k-community structures in special graph classes* (paper 56)	**Pegah Pournajafi** and Nicolas Trotignon. *Burling graphs revisited* (paper 65)	
17:00 - 17:30	Nicolas Bousquet, Quentin Deschamps, Lucas de Meyer, and **Théo Pierron**. *Improved square coloring of planar graphs* (paper 46)	Eric Duchêne, Arthur Dumas, **Nacim Oijid**, Aline Parreau and Eric Rémila. *Maker-Maker Domination Game* (paper 36)	**Jarne Renders**, Jan Goedgebeur, Gábor Wiener and Carol T. Zamfirescu. *On K_2-hamiltonian graphs* (paper 22)	

Tuesday, July 5th (morning)

09:00 - 10:00	Invited Talk (room: Amphi Dumontet, Bât 7): **Martin Grohe**: *The Algebra of Homomorphism Counts*. Chair: Petr Golovach			
10:00 - 10:15	**Coffee break**			
	Room: 36.05 Session 3.1. Chair: Mickaël Montassier	**Room**: 36.06 Session 3.2. Chair: Julien Baste	**Room**: 36.07 Session 3.3. Chair: Tınaz Ekim	**Room**: 36.08 Session 3.4. Chair: Daniel Gonçalves
10:15 - 10:45	Jean-Christophe Godin, Rémi Grisot, and **Olivier Togni**. *List coloring with separation of the complete graph* (paper 53)	**Claire Hilaire** and Jean-Florent Raymond. *Long induced paths in graphs with bounded treewidth* (paper 49)	**Babak Ghanbari** and Javad B. Ebrahimi. *Fractional forcing number of graphs* (paper 58)	**Florian Hörsch**, Tomáš Kaiser and Matthias Kriesell. *Rainbow spanning trees for small color classes* (paper 9)
10:45 - 11:15	Stijn Cambie, **Wouter Cames van Batenburg**, Ewan Davies and Ross J. Kang. *The list-packing number* (paper 32)	**Cyril Gavoille** and Arnaud Labourel. *Smaller Universal Graphs for Caterpillars and Graphs of Bounded Pathwidth* (paper 54)	Stéphane Bessy, Johannes Pardey, Lucas Picasarri-Arrieta and **Dieter Rautenbach**. *Factorially many maximum matchings close to the Erdős-Gallai bound* (paper 3)	Katarína Čekanová, Mária Maceková, **Roman Soták** and Zuzana Šárošiová. *Note on light 3-stars in embedded graphs* (paper 64)
11:15 - 11:45	**Grzegorz Gutowski**, Marcin Anholcer, Bartłomiej Bosek, Jarosław Grytczuk, Jakub Przybyło and Mariusz Zając. *A Note on Generalized Majority Colorings* (paper 82)	**Raphael Steck** and Henning Bruhn-Fujimoto. *Graphs of large treewidth don't have the edge-Erdős-Pósa property* (paper 30)	Fedor V. Fomin, **Petr A. Golovach** and Saket Saurabh. *Matchings in Frameworks* (paper 35)	
12:00 - 14:00	Lunch			

Tuesday, July 5th (afternoon)

14:00 - 15:00	Invited Talk (room: Amphi Dumontet, Bât 7): **Fedor Fomin**: *Long cycles in graphs: Extremal Combinatorics meets Parameterized Algorithms*. Chair: Dimitrios M. Thilikos			
	Room: 36.05 Session 4.1. Chair: Annegret Wagler	**Room**: 36.06 Session 4.2. Chair: Ervin Győri	**Room**: 36.07 Session 4.3. Chair: Emeric Gioan	
15:15 - 15:45	**Dipayan Chakraborty**, Florent Foucaud, Aline Parreau and Annegret K. Wagler. *On three domination-based identification problems in block graphs* (paper 31)	Dániel Grósz, Abhishek Methuku and **Casey Tompkins**. *Ramsey numbers of Boolean lattices* (paper 43)	**Maximilian Gorsky**, Raphael Steiner and Sebastian Wiederrecht. *Matching Theory and Barnette's Conjecture* (paper 12)	
15:45 - 16:15	Florent Foucaud and **Tuomo Lehtilä**. *Improved upper bounds for identifying codes in trees and other graphs* (paper 52)	**Domenico Mergoni**, Peter Allen, Jozef Skokan and Barnaby Roberts. *The Ramsey number of square of paths* (paper 84)	**François Pitois**, Mohammed Haddad, Hamida Seba and Olivier Togni. *Polynomial characterization of the set of r-splits of a graph* (paper 83)	
16:15 - 16:45	**Coffee break**			
	Room: 36.05 Session 5.1. Chair: William Lochet	**Room**: 36.06 Session 5.2. Chair: Cyril Gavoille	**Room**: 36.07 Session 5.3. Chair: Pascal Ochem	
16:45 - 17:15	**Pierre Aboulker**, Guillaume Aubian and Raphael Steiner. *Heroes in orientations of chordal graphs* (paper 23)	**Thomas Dissaux** and Nicolas Nisse. *Pathlength of Outerplanar graphs* (paper 16)	Sagnik Sen, Éric Sopena and **S Taruni**. *Homomorphisms of (n, m)-graphs with respect to generalized switch* (paper 70)	
17:15 - 17:45	Pierre Aboulker, **Guillaume Aubian** and Pierre Charbit. *Heroes in Orientations of Complete Multipartite Graphs* (paper 39)	**Pierre Bergé**, Édouard Bonnet and Hugues Déprés. *Deciding twin-width at most 4 is NP-complete* (paper 6)	**Emeric Gioan**. *On counting orientations for graph homomorphisms and for dually embedded graphs using the Tutte polynomial of matroid perspectives* (paper 73)	

Wednesday, July 6th (morning)

09:00 - 10:00	Invited Talk (room: Amphi Dumontet, Bât 7): **Jean-Sébastien Sereni**: *Spanning trees in regular graphs*. Chair: Frédéric Havet
10:00 - 10:15	**Coffee break**

	Room: 36.05 Session 6.1. Chair: Raul Lopes	**Room**: 36.06 Session 6.2. Chair: Marin Bougeret	**Room**: 36.07 Session 6.3. Chair: Pierre Aboulker	**Room**: 36.08 Session 6.4. Chair: Casey Tompkins
10:15 - 10:45	**Hoang La**, Kolja Knauer and Petru Valicov. *Feedback vertex sets in (directed) graphs of bounded degeneracy or treewidth* (paper 10)	**Felix Bock**, Johannes Pardey, Lucia D. Penso and Dieter Rautenbach. *A bound on the dissociation number* (paper 1)	**Antoine Dailly**, Éric Duchêne, Aline Parreau and Elżbieta Sidorowicz. *Neighbour sum-distinguishing edge colorings with local constraints* (paper 8)	**Gyula Y. Katona**, Khan Humara and Kitti Varga. *Minimally tough graphs in special classes* (paper 50)
10:45 - 11:15	**Jørgen Bang-Jensen**, Kasper Skov Johansen and Anders Yeo. *Making a tournament k-strong by adding new arcs* (paper 77)	Felix Bock, Mitre Costa Dourado, Johannes Pardey, **Lucia Draque Penso** and Dieter Rautenbach. *Hardness of Relating Dissociation, Independence, and Matchings* (paper 34)	Tomáš Madaras and **Alfréd Onderko**. *On edge colorings of graphs with no color-rich cycles* (paper 55)	**Clément Dallard**, Blas Fernández, Gyula Y. Katona and Martin Milanič. *Necessary induced subgraphs of minimally tough graphs* (paper 51)
11:15 - 11:45	**Yun Wang** and Jørgen Bang-Jensen. *Arc-disjoint out- and in-branchings with the same root in co-bipartite digraphs* (paper 79)	**Felicia Lucke** and Bernard Ries. *Transversals of Maximum Independent Sets* (paper 48)	**Jonathan Narboni**. *Vizing's conjecture holds* (paper 85)	
12:00 - 14:00	Lunch			

Wednesday, July 6th (afternoon)

14:00 - 15:00	Invited Talk (room: Amphi Dumontet, Bât 7): **Kristina Vušković**: *Graph structure and algorithms*. Chair: Pierre Aboulker			
	Room: 36.05 Session 7.1. Chair: Petru Valicov	**Room**: 36.06 Session 7.2. Chair: Olivier Togni	**Room**: 36.07 Session 7.3. Chair: Aline Parreau	
15:15 - 15:45	**Thomas Bellitto**, Nicolas Bousquet, Adam Kabela and Théo Pierron. *The smallest 5-chromatic tournament* (paper 45)	Guillaume Bonfante and **Florian Deloup**. *A graph perspective on the genus of regular languages* (paper 5)	Boštjan Brešar, Arti Pandey and **Gopika Sharma**. *Algorithmic Results on Grundy Total Domination and Grundy Double Domination* (paper 41)	
15:45 - 16:15	Pierre Aboulker, Thomas Bellitto, Frédéric Havet and **Clément Rambaud**. *On the minimum number of arcs in 3-dicritical oriented graphs* (paper 27)	**Mohammad Abudayah** and Omar Alomari. *On the Cospectrality of Hermitian Adjacency Matrices of a Mixed Graph* (paper 18)	**A. A. Pereira** and C. N. Campos. *Dominating and Independent Dominating Sets in Goldberg Snarks* (paper 25)	
16:15 - 16:45	**Coffee break**			
	Room: 36.05 Session 8.1. Chair: Petr Golovach	**Room**: 36.06 Session 8.2. Chair: Roman Sotak	**Room**: 36.07 Session 8.3. Chair: Sebastian Wiederrecht	
16:45 - 17:15	**Marco Caoduro**, Jana Cslovjecsek, Michał Pilipczuk and Karol Węgrzycki. *On the hitting/packing ratio of axis-parallel segments* (paper 44)	Omar Alomari and **Mohammad Abudayah**. *On the Inverse of $\alpha-$Hermitian Adjacency Matrix of Mixed Graphs* (paper 17)	Julien Baste, **Antoine Castillon**, Clarisse Dhaenens, Mohammed Haddad and Hamida Seba. *γ-Cluster Edge Modification Problems* (paper 40)	
17:15 - 17:45	Daniel Gonçalves, **Vincent Limouzy** and Pascal Ochem. *Contact graphs of boxes with unidirectional contacts* (paper 61)	**Zin Mar Myint**, Soura Sena Das, Soumen Nandi, Sagnik Sen and Éric Sopena. *A generalization of Brussels sprouts* (paper 72)	**Felix Mann** and Felicia Lucke. *Using Edge Contractions and Vertex Deletions to Reduce the Independence Number and the Clique Number* (paper 57)	

Thursday, July 7th

09:00 - 10:00	Invited Talk (room: Amphi Dumontet, Bât 7): **Gwenaël Joret**: *Product structure of planar graphs*. Chair: David Wood			
10:00 - 10:15	**Coffee break**			
	Room: 36.05 Session 9.1. Chair: Florian Deloup	**Room**: 36.06 Session 9.2. Chair: Vincent Limouzy	**Room**: 36.07 Session 9.3. Chair: Nicolas Nisse	
10:15 - 10:45	**Tobias Hofmann** and Frank Göring. *Certain extremal uniformly connected graphs* (paper 74)	**Florian Galliot**, Sylvain Gravier and Isabelle Sivignon. *$(k-2)$-linear connected components in hypergraphs of rank k* (paper 80)	Julio Araujo, **Marin Bougeret**, Victor Campos and Ignasi Sau. *Introducing* lop*-kernels: a framework for kernelization lower bounds* (paper 24)	
10:45 - 11:15	**Ervin Győri**, Chunqiu Fang, Chuanqi Xiao and Jimeng Xiao. *Turan numbers and anti-Ramsey numbers for short cycles in complete 3-partite graphs* (paper 33)	**Nika Salia**. *Pósa-type results for Berge-hypergraphs* (paper 38)	Julien Baste and **Dimitri Watel**. *An FPT algorithm for node-disjoint subtrees problems parameterized by treewidth* (paper 13)	
11:15 - 11:45	Addisu W. Paulos, **Ervin Győri** and Chuaqi Xiao. *Generalized outerplanar Turán number of short paths* (paper 78)	Dhannya S M, Narayanaswamy N S and **Nisha K K**. *Exactly Hittable Interval Graphs* (paper 76)	Dušan Knop, **Šimon Schierreich** and Ondřej Suchý. *Waypoint routing on bounded treewidth graphs* (paper 21)	
12:00 - 14:00	Lunch			
from 15:00	Social activity + Conference dinner			

Friday, July 8th

09:00 - 10:00	Invited Talk (room: Amphi Dumontet, Bât 7): **David Eppstein**: *Graphs in Nature*. Chair: Jérémie Chalopin			
10:00 - 10:15	**Coffee break**			
	Room: 36.05 Session 10.1. Chair: Stéphane Bessy	**Room**: 36.06 Session 10.2. Chair: Dimitrios M. Thilikos	**Room**: 36.07 Session 10.3. Chair: William Lochet	
10:15 - 10:45	Johannes Pardey and **Dieter Rautenbach**. *Almost balanced perfect matchings in balanced edge-colored complete graphs* (paper 37)	James A. Long Jr., Kevin G. Milans and **Andrea Munaro**. *Non-empty intersection of longest paths in H-free graphs* (paper 81)	**Patrice Ossona de Mendez**, Mario Gobler, Yiting Jiang, Sebastian Siebertz and Alexandre Vigny. *Discrepancy and Sparsity* (paper 20)	
10:45 - 11:15	**Christophe Picouleau** and Valentin Bouquet. *The Perfect Matching-Cut problem in bipartite graphs with diameter two* (paper 15)	**Anni Hakanen**, Ville Junnila, Tero Laihonen and Ismael Yero. *On the Vertices Forced to Be in Every Metric Basis* (paper 26)	Timothée Corsini, Quentin Deschamps, Carl Feghali, Daniel Gonçalves, Hélène Langlois and **Alexandre Talon**. *Partitioning into degenerate graphs in linear time* (paper 68)	
11:15 - 11:45	**Nicolas El Maalouly** and Raphael Steiner. *Exact Matching in Graphs of Bounded Independence Number* (paper 28)	**Santiago Guzmán-Pro**, Pavol Hell and César Hernández-Cruz. *Circular orderings of graphs* (paper 2)	**Laurent Feuilloley**, Nicolas Bousquet and Théo Pierron. *What can be certified compactly? (Compact local certification of MSO properties in tree-like graphs)* (paper 62)	
12:00 - 14:00	Lunch			
14:00 - 15:00	Invited Talk (room: Amphi Dumontet, Bât 7): **Virginia Vassilevska Williams**: *Subgraph Isomorphism for Constant Size Patterns: Algorithms and Hardness*. Chair: Cristophe Paul			
15:00 - 15:15	Conclusion of ICGT 2022			

Invited talks

Invited Talk

Reinhard Diestel: *Canonical graph decompositions via coverings*

Abstract: We present a canonical way to decompose finite graphs into highly connected local parts. The decomposition depends only on an integer parameter whose choice sets the intended degree of locality. The global structure of the graph, as determined by the relative position of these parts, is described by a coarser *model*. This is a simpler graph determined entirely by the decomposition, not imposed.

The model and decomposition are obtained as projections of the tangle-tree structure of a covering of the given graph that reflects its local structure while unfolding its global structure. In this way, the tangle theory from graph minors is brought to bear canonically on arbitrary graphs, which need not be tree-like.

Joint work with Raphael Jacobs, Paul Knappe and Jan Kurkofka

Invited Talk

Vida Dujmović: *Stack and Queue layouts*

Abstract: This talk will focus on two graph parameters: stack layouts (aka. book embeddings) and queue layouts of graphs. I will talk about the history of these two graph parameters, their still not fully understood relationship and some recent breakthroughs.

Invited Talk

Martin Grohe: *The Algebra of Homomorphism Counts*

Abstract: Representations of graphs based on counting homomorphisms provide a surprisingly rich view on graphs with applications ranging from database theory to machine learning. Lovász (1967) showed that two graphs G and H are isomorphic if and only if they are homomorphism indistinguishable over the class of all graphs, i.e., for every graph F, the number of homomorphisms from F to G equals the number of homomorphisms from F to H. Recently, homomorphism indistinguishability over restricted classes of graphs such as bounded treewidth, bounded treedepth and planar graphs, has emerged as a surprisingly powerful framework for capturing diverse equivalence relations on graphs arising from logical equivalences and algebraic equation systems.

In this talk, I will introduce an algebraic framework for such results drawing from linear algebra and representation theory.

The talk is based on joint work with Holger Dell, Gaurav Rattan, and Tim Seppelt.

Invited Talk

Fedor Fomin: *Long cycles in graphs: Extremal Combinatorics meets Parameterized Algorithms*

Abstract: We discuss recent algorithmic extensions of two classic results of extremal combinatorics about long paths in graphs. First, the theorem of Dirac from 1952 asserts that a 2-connected graph G with the minimum vertex degree $d > 1$, is either Hamiltonian or contains a cycle of length at least $2d$. Second, the theorem of Erdős-Gallai from 1959, states that a 2-connected graph G with the average vertex degree $D > 1$, contains a cycle of length at least D. The proofs of these theorems are constructive, they provide polynomial-time algorithms constructing cycles of lengths $2d$ and D. We extend these algorithmic results by showing that each of the problems, to decide whether a 2-connected graph contains a cycle of length at least $2d + k$ or of a cycle of length at least $D + k$, is fixed-parameter tractable parameterized by k.

Invited Talk

Jean-Sébastien Sereni: *Spanning trees in regular graphs*

Abstract: This talks deals with the extremal values of the number of spanning trees over classes of regular graphs. I will present some of the results and tools in this area, in particular those we used to obtain an exact lower bound, with all extremal configurations, for the minimum number of spanning trees in regular loopless multigraphs (for any order and regularity).

This is based on a joint work with Jakub Pekárek and Zelealem B. Yilma.

Invited Talk

Kristina Vušković: *Graph structure and algorithms*

Abstract: In this talk we focus on the structure of hereditary graph classes (those closed under vertex deletion) and the techniques developed to exploit the structure in the construction of efficient algorithms. We consider recognition algorithms, as well as optimization algorithms such as clique, stable set and coloring. There are two key types of cutsets that emerge repeatedly in the study of the structure of hereditary classes: 2-joins and star cutsets. Special cases and generalisations of these two types of cutsets have been used in decomposition theorems for a number of classes such as balanced and balanceable bipartite graphs, perfect graphs, even-hole-free graphs, claw-free graphs, bull-free graphs, and others. We observe that these key cutsets are not bounded in size, and furthermore, the above mentioned decomposition theorems decompose graphs into pieces that are well-structured, but not necessarily bounded in size. For these reasons the dynamic programming approach used in algorithms for classes with bounded width parameters fails on hereditary graph classes, and it becomes a lot harder to use such decomposition theorems to design algorithms. One needs to exploit the structure of the cutset, which is a much more complicated concept than its size.

Invited Talk

Gwenaël Joret: *Product structure of planar graphs*

Abstract: This talk will focus on the following recent "product structure theorem" for planar graphs: Every planar graph G is a subgraph of the strong product of a graph H of treewidth 8 and a path P. Many combinatorial / algorithmic problems on graphs become easy when restricted to graphs of bounded treewidth. One can thus think of the product structure theorem as a tool for extending results that are known to hold for bounded treewidth graphs to planar graphs. Indeed, a number of old open problems about planar graphs have been solved recently in this way, such as bounding the queue-number and the nonrepetitive chromatic number by a constant, designing an adjacency labeling scheme using only $\log_2(n)$ bits roughly, and building universal graphs with few edges. In this talk, I will give a gentle introduction to this research area, and highlight some of the remaining open problems.

Invited Talk

David Eppstein: *Graphs in Nature*

Abstract: Many natural processes produce planar structures that can be modeled mathematically as graphs. These include cracking of sheets of glass or mud, the growth of needle-like crystals, foams of soap bubbles, and the folding patterns of crumpled paper. We survey graph-theoretic models for these phenomena, the properties of the graphs arising from them, and algorithms for recognizing these graphs and reconstructing their geometry.

Invited Talk

Virginia Vassilevska Williams: *Subgraph Isomorphism for Constant Size Patterns: Algorithms and Hardness*

Abstract: We consider the Subgraph Isomorphism (SI) problem: Given two graphs H and G, is H a subgraph of G? This problem is of course NP-complete [Karp'1972]. However, if the number of vertices of H is a constant k, independent of the number of vertices n of G, even the brute force algorithm for SI runs in polynomial time $O(n^k)$. A decades old algorithm by Nešetril and Poljak [1985] for (both induced and not necessarily induced SI) of k-node H and n-node G, reduces the problem to detecting a k-Clique in an $O(n)$ node graph. Then, k-clique detection can be solved faster than $O(n^k)$ time using fast matrix multiplication via an approach due to Itai and Rodeh [1978]. SI for k-Clique is thus the hardest version of SI. For some patterns H that are not k-cliques faster algorithms are known, both for the non-induced and the harder induced case. In this talk I'll present a method for obtaining such faster algorithms for induced SI that we introduced in 2015 (together with Wang, R. Williams and Yu). I will also present some hardness results, connecting the hardness of SI for H in n-node graphs G to the clique number and the chromatic number of H (via the Hadwiger conjecture). This is based on joint work with Mina Dalirrooyfard and June Duong [STOC'19].

Abstracts of contributed talks

Paper 1:

A bound on the dissociation number

Felix Bock, Johannes Pardey, Lucia D. Penso and Dieter Rautenbach.

Abstract: The dissociation number diss(G) of a graph G is the maximum order of a set of vertices of G inducing a subgraph that is of maximum degree at most 1. Computing the dissociation number of a given graph is algorithmically hard even when restricted to subcubic bipartite graphs. For a graph G with n vertices, m edges, k components, and c_1 induced cycles of length 1 modulo 3, we show diss$(G) \geq n - \frac{1}{3}\Big(m + k + c_1\Big)$. Furthermore, we characterize the extremal graphs in which every two cycles are vertex-disjoint.

Paper 2:

Circular orderings of graphs

Santiago Guzmán-Pro, Pavol Hell and César Hernández-Cruz.

Abstract: Each hereditary property can be characterized by its set of minimal obstructions; these sets are often unknown, or known but infinite. By allowing extra structure it is sometimes possible to describe such properties by a finite set of forbidden objects. This has been studied most intensely when the extra structure is a linear ordering of the vertex set. For instance, it is known that a graph G is k-colourable if and only if $V(G)$ admits a linear ordering with no vertices $v_1 \leq v_2 \leq \ldots \leq v_{k+1}$ such that v_i and v_{i+1} are adjacent vertices for every $1 \leq i \leq k$. In this work, we study such characterizations when the extra structure is a circular ordering of the vertex set. We show that the classes that can be described by finitely many forbidden circularly ordered graphs include forests, circular-arc graphs, and graphs with circular chromatic number less than k.

Paper 3:

Factorially many maximum matchings close to the Erdős-Gallai bound

Stéphane Bessy, Johannes Pardey, Lucas Picasarri-Arrieta and Dieter Rautenbach.

Abstract: A classical result of Erdős and Gallai determines the maximum size $m(n, \nu)$ of a graph G of order n and matching number νn. We show that G has factorially many maximum matchings provided that its size is sufficiently close to $m(n, \nu)$.

Paper 5:

A graph perspective on the genus of regular languages

Guillaume Bonfante and Florian Deloup

Abstract: We describe the relationship between the notion of directed graph emulator and automata simplification via Myhill-Nerode equivalence. Both being strongly related, we get a new perspective on the genus of regular languages.

Paper 6:

Deciding twin-width at most 4 is NP-complete

Pierre Bergé, Édouard Bonnet and Hugues Déprés

Abstract: We show that determining if an n-vertex graph has twin-width at most 4 is NP-complete, and requires time $2^{\Omega(n/\log n)}$ unless the Exponential-Time Hypothesis fails. Along the way, we give an elementary proof that n-vertex graphs subdivided at least $2\log n$ times have twin-width at most 4. We also show how to encode trigraphs H (2-edge colored graphs involved in the definition of twin-width) into graphs G, in the sense that every d-sequence (sequence of vertex contractions witnessing that the twin-width is at most d) of G inevitably creates H as an induced subtrigraph, whereas there exists a partial d-sequence that actually goes from G to H. We believe that these facts and their proofs can be of independent interest.

Paper 8:

Neighbour sum-distinguishing edge colorings with local constraints

Antoine Dailly, Éric Duchêne, Aline Parreau and Elżbieta Sidorowicz

Abstract: An edge coloring ω is neighbour sum-distinguishing if the vertex coloring defined by $\sigma_\omega(u) = \sum_{v \in N(u)} \omega(uv)$ is proper. The 1-2-3 Conjecture states that if ω is unrestricted, then ω having 3 colors is enough for any graph. Several variants have been defined, such as ω being proper.

We define a general framework for the problem and its variants, by having local constraints on the coloring. A neighbour sum-distinguishing edge coloring is d-relaxed if every vertex is incident with at most d edges of the same color. We study this variant on trees, complete and subcubic graphs for several values of d. Those results lead us to conjecture that $\lceil \frac{\Delta(G)}{d} \rceil + 2$ colors are enough for any graph. We also study a slightly different framework: each vertex of large enough degree has to be incident with a non-monochromatic set of edges. We prove results for graphs of different maximum degrees and for bipartite graphs.

Paper 9:

Rainbow spanning trees for small color classes

Florian Hörsch, Tomáš Kaiser and Matthias Kriesell

Abstract: Let G be a graph and $\phi : E(G) \to S$ an edge-coloring of G for some set S. A spanning tree T of G is called rainbow if $|\phi^{-1}(s) \cap E(T)| \leq 1$ for every $s \in S$. We consider several packing and covering problems on rainbow spanning trees and similar objects for colorings in which each color class has a small constant size.

Paper 10:

Feedback vertex sets in (directed) graphs of bounded degeneracy or treewidth

Hoang La, Kolja Knauer and Petru Valicov

Abstract: We study the minimum size f of a feedback vertex set in directed and undirected n-vertex graphs of given degeneracy or treewidth. In the undirected setting the bound $\frac{k-1}{k+1}n$ is known to be tight for graphs with bounded treewidth k or bounded odd degeneracy k. We show that neither of the easy upper and lower bounds $\frac{k-1}{k+1}n$ and $\frac{k}{k+2}n$ can be exact for the case of even degeneracy. More precisely, for even degeneracy k we prove that $\frac{3k-2}{3k+4}n \leq f < \frac{k}{k+2}n$.

For directed graphs of bounded degeneracy k, we prove that $f \leq \frac{k-1}{k+1}n$ and that this inequality is strict when k is odd. For directed graphs of bounded treewidth $k \geq 2$, we show that $\frac{k-2\lfloor \log_2(k) \rfloor}{k+1}n \leq f \leq \frac{k}{k+3}n$. Further, we provide several constructions of low degeneracy or treewidth and large f.

Paper 11:

Minimal obstructions for properties related to polarity on cograph superclasses

Fernando Esteban Contreras-Mendoza and César Hernández-Cruz

Abstract: Let s and k be nonnegative integers. An (s,k)-polar graph is a graph G whose vertex set admits a partition (A,B) such that $G[A]$ and $\overline{G[B]}$ are complete multipartite graphs with at most s and k parts, respectively. If s or k is replaced by ∞ it means that the number of parts of $G[A]$ or $\overline{G[B]}$, respectively, is unbounded.

Complete lists of cograph minimal (s,k)-polar obstructions are known when $s = k = \infty$, $s = 1$ and $k = \infty$, $s = 1$ and k is any arbitrary fixed integer, or $s = k = 2$. In this work we generalize all these results giving complete lists of P_4-sparse and P_4-extendible minimal (s,k)-polar obstructions for the said cases.

Additionally, we show that any hereditary property of graphs has only finitely many minimal obstructions when restricted to either P_4-sparse or P_4-extendible graphs, generalizing analogous results for cographs and P_4-reducible graphs.

Paper 12:

Matching Theory and Barnette's Conjecture

Maximilian Gorsky, Raphael Steiner and Sebastian Wiederrecht

Abstract: Barnette's Conjecture claims that all cubic, 3-connected, planar, bipartite graphs are Hamiltonian. Using a matching-theoretic perspective, we can relax the requirement of planarity to give the equivalent conjecture that all cubic, 3-connected, Pfaffian, bipartite graphs are Hamiltonian.

A graph, other than the path of length three, is a brace if it is bipartite and any two disjoint edges are part of a perfect matching. We observe that Barnette's Conjecture can be reduced to cubic, planar braces. We show a similar reduction to braces for cubic, 3-connected, bipartite graphs regarding four stronger versions of Hamiltonicity. Note that in these cases we do not need planarity. As a practical application of these results, we provide some supplements to a generation procedure for cubic, 3-connected, planar, bipartite graphs discovered by Holton et al. in 1985. These allow us to check whether a graph we generated is a brace.

Paper 13:

An FPT algorithm for node-disjoint subtrees problems parameterized by treewidth

Julien Baste and Dimitri Watel

Abstract: We introduce a problem called Minimum subTree problem with Degree Weights, or MTDW, that generalizes covering tree problems. It consists, given an undirected graph $G = (V, E)$, in the search of a forest $(T_1, T_2, \ldots, T_\ell)$ containing ℓ node-disjoint trees of G satisfying some constraints and minimizing an objective function that depend only on the degree of the nodes in the trees.

We investigate MTDW with regard to parameterized complexity with regard to four parameters that are the number of constraints, the maximum degree after which the constraints are constant, the value ℓ, and the treewidth of the input graph G. For this problem, we provide a first dichotomy P versus NP-hard and a second dichotomy FPT versus $\mathsf{W[1]}$-hard depending whether each of these parameters is constant, considered as a parameter, or disregard.

Particularly, our results show that most of the subproblems of MTDW are FPT by treewidth.

Paper 15:

The Perfect Matching-Cut problem in bipartite graphs with diameter two

Christophe Picouleau and Valentin Bouquet.

Abstract: Perfect Matching-Cut is the problem of deciding whether a connected graph has a perfect matching that contains an edge-cut. Deciding whether a graph has a Perfect Matching-Cut is NP-complete even for the class of bipartite graphs with diameter four. The case of bipartite graphs with diameter one is trivial since only K_2 has a Perfect Matching-Cut. We show that it is polynomial to decide whether a bipartite graph with diameter three has a Perfect Matching-Cut.

Paper 16:

Pathlength of Outerplanar graphs

Thomas Dissaux and Nicolas Nisse

Abstract: A *path-decomposition* of a graph $G = (V, E)$ is a sequence of subsets of V, called *bags*, that satisfy some connectivity properties. The *length* of a path-decomposition of a graph G is the greatest distance between two vertices that belong to a same bag and the *pathlength*, denoted by $p\ell(G)$, of G is the smallest length of its path-decompositions. This parameter has been studied for its algorithmic applications for several classical metric problems. Deciding if the pathlength of a graph G is at most 2 is NP-complete, however no result about planar graphs is known. In this work, we first show that $p\ell(C_n) = \lfloor \frac{n}{2} \rfloor$ for any n-cycle C_n and that the pathlength can be computed in linear time in trees. Our main result is a (+1)-approximation algorithm for computing the pathlength of 2-connected outerplanar graphs, based on a characterization of almost optimal (of length at most $p\ell(G) + 1$) path-decompositions of such graphs.

Paper 17:

On the Inverse of $\alpha-$Hermitian Adjacency Matrix of Mixed Graphs

Omar Alomari and Mohammad Abudayah

Abstract: A mixed graph D is a graph that can be obtained from a graph by orienting some of its edges. Let α be a primitive n^{th} root of unity, then the $\alpha-$Hermitian adjacency matrix of a mixed graph is defined to be the matrix $H_\alpha = [h_{rs}]$ where $h_{rs} = \alpha$ if rs is an arc in D, $h_{rs} = \overline{\alpha}$ if sr is an arc in D, $h_{rs} = 1$ if sr is a digon in D and $h_{rs} = 0$ otherwise. Accordingly, in this paper we study the inverse of $\alpha-$hermitian adjacency matrix of a mixed graph.

Paper 18:

On the Cospectrality of Hermitian Adjacency Matrices of a Mixed Graph

Mohammad Abudayah and Omar Alomari

Abstract: A digraph $\mathbb{X}$ where bothways oriented edges considered as non-oriented edges (digons) is called mixed graph. Let α be a unit complex number, then the α-Hermitian adjacency matrix of a mixed graph $\mathbb{X}$ is defined to be the matrix $H_\alpha = [h_{rs}]$ where $h_{rs} = \alpha$ if rs is an arc in $\mathbb{X}$, $h_{rs} = \overline{\alpha}$ if sr is an arc in $\mathbb{X}$, $h_{rs} = 1$ if sr is a digon in $\mathbb{X}$ and $h_{rs} = 0$ otherwise. In this paper we study the cospectrality of the Hermitian adjacency matrices of a mixed graph.

Paper 19:

Infinite families of non-superperfect graphs based on even antiholes

Canguang Lin and Annegret Wagler

Abstract: Given a graph G with non-negative integral node weights w, an interval coloring is an assignment of w_v consecutive colors to the nodes v of G so that adjacent nodes receive different colors. A graph G is superperfect if the maximum weight of a clique in G equals the minimum number of colors needed in an interval coloring of G for all non-negative integral node weights w. A characterization of superperfect graphs by minimal non-superperfect graphs is not yet known. Hoffman (1974) showed that every comparability graph is superperfect, hence all non-superperfect graphs are non-comparability. According to Golumbic (1980), even antiholes are minimal non-comparability superperfect graphs. In this work, we provide infinite families of non-superperfect graphs having even antiholes as only minimal non-comparability subgraphs.

Paper 20:

Discrepancy and Sparsity

Patrice Ossona de Mendez, Mario Gobler, Yiting Jiang, Sebastian Siebertz and Alexandre Vigny

Abstract: We study connections between combinatorial discrepancy and graph degeneracy. We prove that the maximum discrepancy over all subgraphs H of a graph G of the neighborhood set system of H is in $\Omega(\log \deg(G))$ and $O(\deg(G))$, where $\deg(G)$ denotes the degeneracy of G. We also relate weak coloring numbers and discrepancy of graph powers.

We prove that a monotone class of graphs has bounded expansion if and only if all the set systems FO-definable in this class have bounded hereditary discrepancy. We also give a characterization of nowhere dense classes in terms of discrepancy.

We derive a corollary on the discrepancy of neighborhood set systems of edge colored graphs, a polynomial-time algorithm to compute ϵ-approximations of size $O(1/\epsilon)$ for set systems definable in bounded expansion classes, an application to clique coloring, and the non-existence of a quantifier elimination scheme for nowhere dense classes.

Paper 21:

Waypoint routing on bounded treewidth graphs

Dušan Knop, Šimon Schierreich and Ondřej Suchý

Abstract: In the WAYPOINT ROUTING PROBLEM one is given an undirected capacitated and weighted graph G, a source-destination pair $s, t \in V(G)$, and a set $W \subseteq V(G)$ of *waypoints*. The task is to find a walk which starts at the source vertex s, visits, in any order, all waypoints, ends at the destination vertex t, respects edge capacities, that is, traverses each edge at most as many times as is its capacity, and minimizes the cost computed as the sum of costs of traversed edges with multiplicities. We study the problem for graphs of bounded tree-width and present a new algorithm for the problem working in $2^{\mathcal{O}(\mathrm{tw})} \cdot n$ time, significantly improving upon the previously known algorithms. To complement the algorithmic part, we show that the running time of the algorithms is optimal for the problem under the Exponential Time Hypothesis. Finally, we show that the problem admits no polynomial kernel w.r.t. the treewidth of the underlying graph.

Paper 22:

On K_2-hamiltonian graphs

Jarne Renders, Jan Goedgebeur, Gábor Wiener and Carol T. Zamfirescu

Abstract: Motivated by a conjecture of Grünbaum and a problem by Katona, Kostochka, Pach and Stechkin, we study K_2-(hypo)hamiltonian graphs. These are (non-hamiltonian) graphs in which the removal of any pair of adjacent vertices yields a hamiltonian graph. Using computational methods we show that Petersen's graph is the smallest K_2-hypohamiltonian graph and classify their existence for all but two orders. In addition, we fully classify the existence of K_2-hypohamiltonian graphs for all orders in the class of cubic graphs and classify all K_2-hypohamiltonian snarks up to 36 vertices. Finally, we also determine the smallest planar K_2-hypohamiltonian graph of girth 5 and the smallest cubic planar K_2-hypohamiltonian graph and show that there exist planar K_2-hypohamiltonian graphs for every order from 177 onward.

Paper 23:

Heroes in orientations of chordal graphs

Pierre Aboulker, Guillaume Aubian and Raphael Steiner

Abstract: We characterize all digraphs H such that orientations of chordal graphs with no induced copy of H have bounded dichromatic number.

Paper 24:

Introducing lop-kernels: a framework for kernelization lower bounds

Julio Araujo, Marin Bougeret, Victor Campos and Ignasi Sau

Abstract: We introduce a simple general framework to obtain kernelization lower bounds for a certain type of kernels for optimization problems, which we call lop-*kernels*. Informally, this type of kernels is required to preserve large optimal solutions in the reduced instance, and captures the vast majority of existing kernels in the literature. As a consequence of this framework, we show that the trivial quadratic kernel for Maximum Minimal Vertex Cover (MMVC) is essentially optimal, answering a question of Boria et al. [Discret. Appl. Math. 2015], and that the known cubic kernel for Maximum Minimal Feedback Vertex Set is also essentially optimal. We present further applications for Tree Deletion Set and for Maximum Independent Set on K_t-free graphs.

Paper 25:

Dominating and Independent Dominating Sets in Goldberg Snarks

A. A. Pereira and C. N. Campos

Abstract: A set S of vertices of a graph G is said to be a dominating set if every vertex of G either belongs to S or is adjacent to some vertex in S. The domination number $\gamma(G)$ of G is the minimum cardinality of a dominating set of G. An independent dominating set in a graph is a set that is both dominating and independent. The minimum cardinality of an independent dominating set $i(G)$ of G is the independent domination number of G. We show that, for every Goldberg Snark G_l, $l \geq 3$ and l odd, it holds that $\gamma(G_l) = i(G_l) = \lceil \frac{11l}{5} \rceil$.

Paper 26:

On the Vertices Forced to Be in Every Metric Basis

Anni Hakanen, Ville Junnila, Tero Laihonen and Ismael Yero

Abstract: We study vertices that belong to all (strong) metric bases of a graph, i.e., to all (strong) resolving sets of minimum cardinality; such vertices are called *(strong) basis forced*. Although we also consider them in general graphs, we mainly focus on unicyclic graphs. In particular, we give a characterization of branch-active unicyclic graphs containing basis forced vertices.

Paper 27:

On the minimum number of arcs in 3-dicritical oriented graphs

Pierre Aboulker, Thomas Bellitto, Frédéric Havet and Clément Rambaud

Abstract: We prove that every 3-dicritical oriented graph on n vertices has at least $\frac{7n+2}{3}$ arcs. We also give a construction of 3-dicritical oriented graphs on n vertices with $\frac{5n}{2}$ arcs for all even $n \geq 12$.

Paper 28:

Exact Matching in Graphs of Bounded Independence Number

Nicolas El Maalouly and Raphael Steiner

Abstract: In the *Exact Matching Problem* (EM), we are given a graph equipped with a fixed coloring of its edges with two colors (red and blue), as well as a positive integer k. The task is then to decide whether the given graph contains a perfect matching exactly k of whose edges have color red. Despite EM being quite well-known, attempts to devise deterministic polynomial algorithms have remained illusive during the last 40 years and progress has been lacking even for very restrictive classes of input graphs. In this paper we finally push the frontier of positive results forward by proving that EM can be solved in deterministic polynomial time for input graphs of bounded independence number, and for bipartite input graphs of bounded bipartite independence number. This generalizes previous positive results for complete (bipartite) graphs which were the only known results for EM on dense graphs.

Paper 30:

Graphs of large treewidth don't have the edge-Erdős-Pósa property

Raphael Steck and Henning Bruhn-Fujimoto

Abstract: We show that for every subcubic graph H of treewidth at least 1000, the set of graphs that contains H as a minor does not have the edge-Erdős-Pósa property.

Paper 31:

On three domination-based identification problems in block graphs

Dipayan Chakraborty, Florent Foucaud, Aline Parreau and Annegret K. Wagler

Abstract: The problems of determining minimum identifying or (open) locating-dominating codes are special search problems that are challenging from both theoretical and computational viewpoints. In these problems, one selects a dominating set C from the vertex set $V(G)$ of a graph G such that the vertices of a chosen subset of $V(G)$ (e.g. $V(G) \setminus C$ or $V(G)$ itself) are uniquely determined by their neighborhoods in C. Hence, a typical line of attack for these problems is to determine tight bounds for the minimum codes in special graphs. In this work, we do the same for block graphs (i.e. diamond-free chordal graphs). We present for all three codes tight lower and upper bounds, and examples of block graphs which attain these bounds. Our upper bounds are in terms of the number of maximal cliques $n_Q(G)$, the order $|V(G)|$ and other structural properties of a block graph G. As for the lower bounds, we prove them to be linear in terms of (i) $n_Q(G)$, and (ii) the order of G.

Paper 32:

The list-packing number

Stijn Cambie, Wouter Cames van Batenburg, Ewan Davies and Ross J. Kang

Abstract: Given the assignment of a list $L(v)$ of k colours to each vertex $v \in V(G)$, we study the existence of k pairwise-disjoint proper colourings of G using colours from these lists. We refer to this as a *list-packing* and we define the *list-packing number* $\chi_\ell^\star(G)$ as the smallest k for which every list-assignment of G admits a list-packing. We prove several results that (asymptotically) match the best-known bounds for the list chromatic number, among which: $\chi_\ell^\star(G) \leq n$ with equality if and only if G is the complete graph on n vertices, $\chi_\ell^\star(G) \leq (1 + o(1)) \log_2(n)$ if G is bipartite on n vertices, and $\chi_\ell^\star(G) \leq (1 + o(1))\Delta/\log(\Delta)$ if G is bipartite with maximum degree Δ. We conjecture that the last statement also holds for triangle-free graphs. Our main open question is whether $\chi_\ell^\star(G)$ can be bounded by a constant times the list chromatic number.

Paper 33:

Turan numbers and anti-Ramsey numbers for short cycles in complete 3-partite graphs

Ervin Győri, Chunqiu Fang, Chuanqi Xiao and Jimeng Xiao

Abstract: We call a 4-cycle in K_{n_1,n_2,n_3} multipartite, denoted by C_4^{multi}, if it contains at least one vertex in each part of K_{n_1,n_2,n_3}. The Turán number $ex(K_{n_1,n_2,n_3}, C_4^{\text{multi}})$ (respectively, $ex(K_{n_1,n_2,n_3}, \{C_3, C_4^{\text{multi}}\})$) is the maximum number of edges in a graph $G \subseteq K_{n_1,n_2,n_3}$ such that G contains no C_4^{multi} (respectively, G contains neither C_3 nor $C_4^{\text{multi}}\Big)$. We call an edge-colored C_4^{multi} rainbow if all four edges of it have different colors. The anti-Ramsey number $ar(K_{n_1,n_2,n_3}, C_4^{\text{multi}})$ is the maximum number of colors in an edge-colored K_{n_1,n_2,n_3} with no rainbow C_4^{multi}. In this paper, we determine that $ex(K_{n_1,n_2,n_3}, C_4^{\text{multi}})$ and $ar(K_{n_1,n_2,n_3}, C_4^{\text{multi}})$.

Paper 34:

Hardness of Relating Dissociation, Independence, and Matchings

Felix Bock, Mitre Costa Dourado, Johannes Pardey, Lucia Draque Penso and Dieter Rautenbach

Abstract: A dissociation set in a graph is a set of vertices inducing a subgraph of maximum degree at most 1. Computing the dissociation number $\text{diss}(G)$ of a given graph G, defined as the order of a maximum dissociation set in G, is algorithmically hard even when G is restricted to be bipartite. The dissociation number of a graph G satisfies $\max\{\alpha(G), 2\nu_s(G)\} \leq \text{diss}(G) \leq \alpha(G) + \nu_s(G) \leq 2\alpha(G)$, where $\nu_s(G)$ denotes the induced matching number of G. We show that deciding whether $\text{diss}(G)$ equals any of the four terms lower and upper bounding $\text{diss}(G)$ is always NP-hard for general graphs, and in some cases also for bipartite graphs, but not always.

Paper 35:

Matchings in Frameworks

Fedor V. Fomin, Petr A. Golovach and Saket Saurabh

Abstract: We say that a pair $(G, \mathcal{M})$, where G is a graph and $\mathcal{M} = (V(G), \mathcal{I})$ is a matroid on the vertex set of G, is a framework. We consider the MAX RANK MATCHING problem that, given a framework $(G, \mathcal{M})$, asks for a matching M of maximum rank with respect to $\mathcal{M}$, that is, we maximize the rank of the set of vertices saturated by M. Our main combinatorial result is an analog of the classical Berge's lemma for frameworks. Using this result, we show that MAX RANK MATCHING can be solved in $\mathcal{O}(n^4)$ time on frameworks $(G, \mathcal{M})$, where G is an n-vertex graph and $\mathcal{M}$ is given by the independence oracle.

Paper 36:

Maker-Maker Domination Game

Eric Duchêne, Arthur Dumas, Nacim Oijid, Aline Parreau and Eric Rémila

Abstract: We introduce the Maker-Maker Domination Game, a perfect information game played on an undirected graph G. Two players color alternately an uncolored vertex of the graph. The first player that colors a dominating set wins, or the game is a draw if none of them manage to complete one. This game takes place in the positional game theory and is the natural Maker- Maker variant of the Maker-Breaker Domination Game, introduced by Duchene et al. [Discret. Math. 2020]. As any Maker-Maker positional game, the second player cannot win. Therefore the best outcome that the second player can hope is a draw. We prove that deciding whether the first player has a winning strategy or not on a graph G is a PSPACE-complete problem even if G is a split or bipartite graph. We study some local structures that can give information on the graph, and we prove that deciding the outcome of the game be can be done in polynomial time if G is a cycle or a tree.

Paper 37:

Almost balanced perfect matchings in balanced edge-colored complete graphs

Johannes Pardey and Dieter Rautenbach

Abstract: We call a graph with a k-edge coloring c *balanced*, if every color appears equally often. We contribute to a question posed by Kittipassorn and Sinsap [arxiv:2011.00862v1], who asked whether every balanced complete graph K_{2kn} with a k-edge coloring contains a balanced perfect matching. While this question has previously been answered affirmatively for $k = 2$, we show that it is not true in general. However, we believe that there are always *almost* balanced perfect matchings. To measure the deviation of a matching from being balanced, we introduce the function $f(M) = f_{k,n,c}(M) = \sum_{i=1}^{k} \left| \left|c^{-1}(i) \cap M\right| - n \right|$. We show that for any balanced complete graph, we can find a perfect matching M with $f(M) \leq 3k\sqrt{kn\ln(2k)}$ and for $k = 3$ a perfect matching M with $f(M) \leq 2$, which is tight in some cases. We conjecture that for general k there is always a perfect matching with $f(M) \leq \mathcal{O}(k^2)$.

Paper 38:

Pósa-type results for Berge-hypergraphs

Nika Salia

Abstract: A Berge-cycle of length k in a hypergraph $\mathcal{H}$ is a sequence of distinct vertices and hyperedges $v_1, h_1, v_2, h_2, \ldots, v_k, h_k$ such that $v_i, v_{i+1} \in h_i$ for all $i \in [k]$, indices taken modulo k. Füredi, Kostochka and Luo recently gave sharp Dirac-type minimum degree conditions that force non-uniform hypergraphs to have a Hamiltonian Berge-cycles. We give a sharp Pósa-type lower bound for r-uniform and non-uniform hypergraphs that force Hamiltonian Berge-cycles.

Paper 39:

Heroes in Orientations of Complete Multipartite Graphs

Pierre Aboulker, Guillaume Aubian and Pierre Charbit

Abstract: We almost characterize digraphs H such that orientations of complete multipartite graphs with no induced copy of H have bounded dichromatic number.

Paper 40:

γ-Cluster Edge Modification Problems

Julien Baste, Antoine Castillon, Clarisse Dhaenens, Mohammed Haddad and Hamida Seba

Abstract: We introduce the γ-Cluster Edge Modification problems, which are variants of the Cluster Editing problem, and defined as: given a graph G, how many edges must be edited (deleted or added) in order to have a disjoint union of quasi-cliques. We provide the complexity classification of most of these problems, and present results on the approximability of some problems as well as a dynamic programming algorithm based on the tree-decomposition of the input graph.

Paper 41:

Algorithmic Results on Grundy Total Domination and Grundy Double Domination

Boštjan Brešar, Arti Pandey and Gopika Sharma

Abstract: A sequence S of vertices is called a total dominating sequence of a graph G, if every vertex in the sequence dominates a vertex which was not dominated by the previous vertices in S. Given a graph G, the Grundy Total Domination (GTD) problem is to find a total dominating sequence of maximum length. We refine some previously known results on bipartite graphs by showing that the GTD problem is NP-complete in perfect elimination bipartite graphs and give a linear-time algorithm for this problem in chain graphs. A sequence $S$is a double dominating sequence if every vertex $v_i \in S$ dominates at least one vertex that has not been dominated by at least two vertices preceding v_i . The Grundy Double Domination (GDD) problem is defined in a similar way. We prove that it is NP-complete for split graphs and present an algorithm that solves this problem for threshold graphs efficiently.

Paper 42:

Maximum size of a triangle-free graph with bounded maximum degree and matching number

Milad Ahanjideh, Tınaz Ekim and Mehmet Akif Yıldız

Abstract: Determining the maximum number of edges under degree and matching number constraints have been solved for general graphs. Since extremal graphs contain claws, C_4's and triangles, it is interesting to ask if the maximum number of edges decreases when these structures are forbidden separately. The first two cases being already settled, here we focus on triangle-free graphs. Unlike the previous results, forbidding triangles decreases the number of edges and adds to the hardness of the problem. We provide a formula giving the maximum number of edges in a triangle-free graph with degree at most d and matching number at most m for all cases where $d \geq m$, and for the cases where $d < m$ with either $d \leq 6$ or $Z(d) \leq m < 2d$ where $Z(d)$ is roughly $5d/4$. We provide an integer programming formulation for the remaining cases and further discuss this formulation to conjecture that our formula giving the size of triangle-free extremal graphs is also valid for these open cases.

Paper 43:

Ramsey numbers of Boolean lattices

Dániel Grósz, Abhishek Methuku and Casey Tompkins

Abstract: The poset Ramsey number $R(Q_m, Q_n)$ is the smallest integer N such that any blue-red coloring of the elements of the Boolean lattice Q_N has a blue induced copy of Q_m or a red induced copy of Q_n. The weak poset Ramsey number $R_w(Q_m, Q_n)$ is defined analogously, with weak copies instead of induced copies.

Axenovich and Walzer showed that $n+2 \leq R(Q_2, Q_n) \leq 2n+2$. Recently, Lu and Thompson improved the upper bound to $\frac{5}{3}n+2$. We solve this problem asymptotically by showing that $R(Q_2, Q_n) = n + O(n/\log n)$. Recent work of Axenovich and Winter implies that the $n/\log n$ term is required.

In the diagonal case, Cox and Stolee proved $R_w(Q_n, Q_n) \geq 2n + 1$ using a probabilistic construction. In the induced case, Bohman and Peng showed $R(Q_n, Q_n) \geq 2n + 1$ using an explicit construction. Improving these results, we show that $R_w(Q_m, Q_n) \geq n + m + 1$ for all $m \geq 2$ and large n by giving an explicit construction.

Paper 44:

On the hitting/packing ratio of axis-parallel segments

Marco Caoduro, Jana Cslovjecsek, Michał Pilipczuk and Karol Węgrzycki

Abstract: Let $\mathcal{S}$ be a set of segments on the plane. The *hitting number* $\tau(\mathcal{S})$ is the minimum number of points hitting all the segments in $\mathcal{S}$, while the *packing number* $\nu(\mathcal{S})$ is the maximum number of pairwise disjoint segments in $\mathcal{S}$. Clearly, $\tau \geq \nu$. It is straightforward and well-known that for segments lying in at most d directions $\tau \leq d\nu$.

We construct a sequence of sets of axis-parallel segments with a ratio τ/ν that approaches 2 as τ (and ν) grows. This shows that the previous bound is optimal for $d = 2$.

A famous conjecture of Wegner (1965) says that for any set of axis-parallel rectangles, the hitting number is bounded by twice the packing number. Our result implies that the multiplicative constant in the conjecture is tight already for the degenerate case of axis-parallel segments.

Paper 45:

The smallest 5-chromatic tournament

Thomas Bellitto, Nicolas Bousquet, Adam Kabela and Théo Pierron

Abstract: A dicoloring of a directed graph, as introduced by Neumann-Lara, is a partition of the graph in sets of vertices that induce graphs with no directed cycles. A directed graph is said to be oriented if there exists at most one arc between each pair of vertices. While it is obvious that the complete directed graph with n vertices is the smallest n-chromatic graph, finding the smallest oriented graph that requires n colors is a very interesting and challenging problem. It is already known that the smallest 2-, 3- and 4-chromatic oriented graphs have respectively 3, 7 and 11 vertices. However, the question of the smallest oriented graph of dichromatic number 5 has been open since 1994, when Neumann-Lara conjectured that the answer was 17. We solve the problem by proving that it actually has size 19.

Paper 46:

Improved square coloring of planar graphs

Nicolas Bousquet, Lucas de Meyer, Quentin Deschamps and Théo Pierron

Abstract: Square coloring is a variant of graph coloring where vertices within distance 2 must receive different colors. When considering planar graphs, the most famous conjecture about this coloring (Wegner, 1977) states that $\frac{3}{2}\Delta + 1$ colors are sufficient to square color every planar graph of maximum degree Δ. This conjecture has been proven asymptotically for graphs with large maximum degree. We consider here planar graphs with small maximum degree and show that $2\Delta + 7$ colors are sufficient, which improves the best known bounds when $6 \leq \Delta \leq 31$.

Paper 47:

On Strict Brambles

Emmanouil Lardas, Evangelos Protopapas, Dimitrios M. Thilikos and Dimitris Zoros

Abstract: A *strict bramble* of a graph G is a collection of pairwise-intersecting connected subgraphs of G, whose *order* is the minimum set of vertices intersecting all its sets. The *strict bramble number* of G, denoted $\mathsf{sbn}(G)$, is the maximum order of a strict bramble in G. sbn is a way to extend acyclicity, as for acyclic graphs every strict bramble has order 1. We study this parameter by providing three equivalent definitions. The first asserts that $\mathsf{sbn}(G)$ is the minimum k for which G is a minor of the lexicographic product of a tree and a clique on k vertices. The second is in terms of a new variant of a tree decomposition called lenient. We show that $\mathsf{sbn}(G)$ is the minimum k for which there is a lenient tree decomposition of G of width at most k. The third is in terms of extremal graphs. For this we introduce k-domino-trees and show these are edge-maximal graphs of $\mathsf{sbn} \leq k$. We also identify the obstruction set of $\mathsf{sbn} \leq 2$. Finally we show that deciding whether $\mathsf{sbn}(G) \leq k$ is an NP-complete problem.

Paper 48:

Transversals of Maximum Independent Sets

Felicia Lucke and Bernard Ries

Abstract: For a given family of vertex sets $\mathcal{C}$, a d-transversal of $\mathcal{C}$ is a set of vertices intersecting every set in $\mathcal{C}$ in at least d elements. Well known transversal problems are for example Vertex Cover, Feedback Vertex Set and Odd Cycle Transversal. We consider d-transversals of maximum independent sets, where we want the set S to be of minimum size and to intersect every maximum independent set in d elements. We show how to represent independent sets in interval graphs as paths in a directed acyclic graph. By joining multiple copies of this directed acyclic graph we construct a graph on which a minimum vertex cut corresponds to a d-transversal of the original graph. Further, we give some complexity results for other subclasses of perfect graphs.

Paper 49:

Long induced paths in graphs with bounded treewidth

Claire Hilaire and Jean-Florent Raymond

Abstract: Esperet, Lemoine and Maffray conjectured in 2017 that every k-degenerate graph that has a path on n vertices also has an induced path on at least $(\log n)^{\Omega_k(1)}$ vertices.

In this talk we prove that every graph of pathwidth less than k with an n-path has an induced path of order at least $\frac{1}{3}n^{1/k}$. This is an exponential improvement and a generalization of the previous polylogarithmic lower bounds for interval graphs of bounded clique number. This result is complemented with an upper bound. We use this result to prove the conjecture for graphs of treewidth less than k: their longest induced path has order at least $\frac{1}{4}(\log n)^{1/k}$.

Paper 50:

Minimally tough graphs in special classes

Gyula Y. Katona, Khan Humara and Kitti Varga

Abstract: Let t be a real number. A graph is called t-tough if the removal of any vertex set S that disconnects the graph 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. We investigate the minimum degree and the recognizability of minimally t-tough graphs in the classes of chordal graphs, split graphs, claw-free graphs, and $2K_2$-free graphs.

Paper 51:

Necessary induced subgraphs of minimally tough graphs

Clément Dallard, Blas Fernández, Gyula Y. Katona and Martin Milanič

Abstract: A graph G is minimally t-tough if G has toughness t and for any edge e of G, the graph $G-e$ is not t-tough. Katona, Soltész, and Varga showed that for every positive rational number t, any graph is an induced subgraph of some minimally t-tough graph. Hence, no induced subgraph can be excluded for the class of minimally t-tough graphs. We consider the opposite point of view and ask which induced subgraphs, if any, must necessarily be present in each minimally t-tough graph. Katona and Varga showed that for all $t \in (1/2, 1]$, every minimally t-tough graph contains a hole, that is, an induced cycle of length at least four. We complement this result by showing that for all finite $t > 1$, every minimally t-tough graph must contain a hole or an induced subgraph isomorphic to the k-sun for some $k \geq 3$. Our approach also shows that for all finite $t > 1$, every minimally t-tough graph containing a universal vertex also contains a hole.

Paper 52:

Improved upper bounds for identifying codes in trees and other graphs

Florent Foucaud and Tuomo Lehtilä

Abstract: A dominating set C of a graph G is an identifying code if any two distinct vertices of G have distinct closed neighbourhoods within C. We prove new upper bounds for the size of the smallest (optimal) identifying codes in bipartite graphs which do not have twins of degree two or greater, and in graphs of girth at least 5. We show that $(n+\ell)/2$ is a tight upper bound for optimal identifying codes in the bipartite case, where n is the order and ℓ is the number of leaves of the graph. This bound is an improvement over two previous bounds for trees, in size and generality. Moreover, the bound is tight for several structurally different infinite families of trees. We derive from our bound a tight upper bound of $2n/3$ for twin-free bipartite graphs of order n, and give an exact characterization for graphs attaining it. Then we give an upper bound of $(5n+2\ell)/7$ for identifying codes in graphs of girth at least 5.

Paper 53:

List coloring with separation of the complete graph

Jean-Christophe Godin, Rémi Grisot and Olivier Togni

Abstract: We consider the problem of computing, for a graph G and integers a, b, the *separation number* of G which is the largest integer c such that there exists a list assignment of G with the properties that $|L(x) \cap L(y)| \leq c$ for any edge xy, $|L(x)| = a$ for any vertex x, and G is (L, b)-colorable, i.e., from each list $L(x)$, one can choose a b-element subset in such a way that adjacent vertices receive disjoint subsets. We concentrate on the complete graph and prove exact values and bounds for its separation number.

Paper 54:

Smaller Universal Graphs for Caterpillars and Graphs of Bounded Pathwidth

Cyril Gavoille and Arnaud Labourel

Abstract: We give an explicit construction of a graph $\mathcal{U}_n$ with at most $8n$ vertices with the property that every n-vertex caterpillar graph is isomorphic to some induced-subgraph of $\mathcal{U}_n$. Previous constructions of so-called induced-universal graph for caterpillars used 256n vertices in the best (Bonichon et al. SIROCCO'06 and Alstrup et al. FOCS'15).

We extended this result to path-width-p graphs with an induced-universal graph of $n \cdot 2^{O(p)}$ vertices. This is complemented with a $n \cdot 2^{\Omega(p)}$ lower bound. With bounded path-width graphs, our construction considerably enlarge the family of n-vertex graphs having an induced-universal graph of $O(n)$ vertices, which is optimal. Such unexpected property was known only for trees, bounded maximum degree outerplanar graphs and maximum degree-2 graphs.

The extended result is obtained from an algorithmic approach by designing an adjacency labeling scheme for these graphs using $\log n + O(p)$ bit vertex labels and with a constant time adjacency test.

Paper 55:

On edge colorings of graphs with no color-rich cycles

Tomáš Madaras and Alfréd Onderko

Abstract: For a graph G and an integer i, let $\mathcal{K}_i^\circ(G)$ be the maximum number of colors in an edge-coloring of G such that each its cycle contains at most i colors. We explore basic properties and estimates of this coloring invariant. We give a greedy-based degree-related general lower bounds for $\mathcal{K}_i^\circ(G)$ when $i \geq 3$ and discuss their sharpness. In particular, we provide the exact value for $\mathcal{K}_3^\circ(G)$ and $\mathcal{K}_2^\circ(G)$ for G being 5-connected or 3-connected, respectively. Furthermore, we show that, for a graph G of vertex connectivity 2, the exact value of $\mathcal{K}_2^\circ(G)$ can be found by maximizing the number of components after deleting a 2-cut, and, if G is highly connected, then the exact value is 2. We also provide upper bounds in terms of anti-Ramsey numbers for the cycles of length $i + 1$ and discuss the effectiveness of these bounds.

Paper 56:

On k-community structures in special graph classes

Narmina Baghirova, Clément Dallard, Bernard Ries and David Schindl

Abstract: A k-community structure in a graph is a partition of its vertex set into k sets, called communities, such that every vertex of the graph has proportionally at least as many vertices in its own community as in any other. In this paper, we introduce several properties that have to be satisfied by the vertices of a graph whenever it admits a 2-community structure. We show that a tree T admits a k-community structure that can be found in polynomial time if and only if T has a matching of size at least k, for $k \geq 2$. Furthermore, we define a subfamily of threshold graphs and show that it always admits a 2-community structure that can be found in linear time. We finally introduce an infinite family of graphs, which can have odd or even size, that does not admit any 2-community structure.

Paper 57:

Using Edge Contractions and Vertex Deletions to Reduce the Independence Number and the Clique Number

Felix Mann and Felicia Lucke

Abstract: For a graph G and two integers k and d, can we apply a graph operation at most k times to reduce a given graph parameter π by at least d? We show that this problem is NP-hard when the parameter is independence number and the graph operation is vertex deletion or edge contraction, even for $d = 1$ and when restricted to chordal graphs. We also give a polynomial time algorithm for bipartite graphs when the operation is edge contraction, the parameter is independence number and d is fixed. Further, we complete the complexity dichotomy on H-free graphs when the parameter is the clique number and the operation is edge contraction by showing that this problem is NP-hard in $(C_3 + P_1)$-free graphs even for fixed $d = 1$. This answers open questions stated in [Diner et al., Theoretical Computer Science, 746, p. 49-72 (2012)].

Paper 58:

Fractional forcing number of graphs

Babak Ghanbari and Javad B. Ebrahimi

Abstract: In this work, we introduce the notion of the forcing function of fractional perfect matchings, which is continuous analogous to forcing sets defined over the perfect matching polytope of graphs. We study analytic properties of this function. Finally, we deduce bounds and results for the integral forcing number from these analytic properties.

Paper 59:

The bondage number of chordal graphs

Valentin Bouquet

Abstract: A set $S \subseteq V(G)$ of a graph G is a dominating set if each vertex in $V(G) \setminus S$ has a neighbor in S. Let $\gamma(G)$ be the cardinality of a minimum dominating set in G. The bondage number $b(G)$ of a graph G is the smallest cardinality of a set edges $A \subseteq E(G)$ such that $\gamma(G - A) = \gamma(G) + 1$. A chordal graph has no induced cycle of length four or more. We show that the bondage number of a chordal graph G is at most the order of its maximum clique, that is, $b(G) \leq \omega(G)$. We show that this bound is best possible.

Paper 60:

Obstruction Set Constructibility of Minor-Closed Graph Classes

Fedor V. Fomin, Petr A. Golovach, Ignasi Sau, Giannos Stamoulis and Dimitrios M. Thilikos

Abstract: We introduce a new operation between graph classes and we prove the existence of an explicitly constructive bound on the size of the obstruction set of the resulting class, i.e., the set of minor-minimal graphs not belonging to the class. We define the binary operation $\blacktriangleright$ between minor-closed graph classes as follows. Given a graph G and a set $X \subseteq V(G)$, the torso of X in G is the graph obtained from G after removing all vertices not in X and making adjacent each pair of non-adjacent vertices in X that are connected by a path whose internal vertex are not in X. Given two minor-closed graph classes $\mathcal{B}$ and $\mathcal{G}$, we set $\mathcal{B} \blacktriangleright \mathcal{G}$ to be the class of all graphs G for which there is some set $X \subseteq V(G)$ such that the torso of X in

G belongs to $\mathcal{B}$ and the graph obtained from G after the removal of X belongs to $\mathcal{G}$. We prove that if the obstruction set of $\mathcal{B}$ contains at least one planar graph, then the size of the obstructions of $\mathcal{B} \blacktriangleright \mathcal{G}$ is bounded by a computable function of the size of the obstructions of $\mathcal{B}$ and $\mathcal{G}$.

Paper 61:

Contact graphs of boxes with unidirectional contacts

Daniel Gonçalves, Vincent Limouzy and Pascal Ochem

Abstract: This paper is devoted to the study of particular classes of geometrically defined intersection classes of graphs. Those were previously studied in [Magnant and Martin 2011], where the authors shown that these graphs have arbitrary large chromatic number, while being triangle free. We give several structural properties of these graphs, and we raise several questions. These graphs have the particular feature to serve as a counter-example for a conjecture in [Atminas et al. 2018].

Paper 62:

What can be certified compactly? (Compact local certification of MSO properties in tree-like graphs)

Laurent Feuilloley, Nicolas Bousquet and Théo Pierron

Abstract: Local certification consists in assigning labels (called *certificates*) to the vertices of a graph G, in order to certify a property of G (*e.g.* planarity). The verification of this certification must be local: a node typically sees only its neighbors. The main measure of performance of a certification is the size of its certificates, which can be seen as a measure of the globality of the property.

A certification with labels of size $O(\log n)$ is called *compact*. It is known that being planar, having bounded-genus, and forbidding some minors are properties that have compact certifications.

In this work, we are interested in meta-theorems (similar to Courcelle's theorem). We design compact certification for MSO logic on trees and bounded-treedepth graphs, and prove matching lower bounds.

Paper 63:

Interval vertex coloring

Mária Maceková, Roman Soták and Zuzana Šárošiová

Abstract: A vertex k-coloring (not necessarily proper) is an open (closed) interval k-coloring if for every vertex v the set of colors used on the open (closed) neighborhood of v forms an interval of integers. If G is a graph then the largest k for which there exists an open (closed) interval k-coloring of G is called open (closed) interval chromatic number of G, and we denote it by $\chi_{io}(G)$ $(\chi_{ic}(G))$. We present the exact value of open and closed interval chromatic numbers of trees, cycles, complete graphs and wheels.

Paper 64:

Note on light 3-stars in embedded graphs

Katarína Čekanová, Mária Maceková, Roman Soták and Zuzana Šárošiová

Abstract: By $g(k,t)$ we denote the smallest integer such that every plane graph with girth $g \geq g(k,t)$, minimum degree at least 2, and no $(k+1)$-paths consisting of vertices of degree 2 has a 3-vertex with at least t neighbors of degree 2. Borodin and Ivanova completed the list of values of $g(k,t)$ for all $k \geq 1$ and $1 \leq t \leq 3$.

By $g^*(k,t)$ we denote the smallest integer for which there exists an (integer) function $f(k)$ such that for every surface $\mathcal{S}$ with non-positive Euler characteristic $\chi(\mathcal{S})$ and every graph G embedded on $\mathcal{S}$ with $|V(G)| > f(k)|\chi(\mathcal{S})|$, $g(G) \geq g^*(k,t)$, $\delta(G) \geq 2$, and no $(k+1)$-path consisting of vertices of degree 2, $k \geq 1$, G has a 3-vertex with at least t neighbors of degree 2. We have showed that $g^*(k,1) = 4k+5$ if $f(k) \geq 10k+5$, $g^*(k,2) = 4k+5$ if $f(k) \geq 16k+11$, and $g^*(k,3) = 4k+7$ if $f(k) \geq 30k+30$. Moreover, we will discuss the quality of our results.

Paper 65:

Burling graphs revisited

Pegah Pournajafi and Nicolas Trotignon

Abstract: The class of Burling graphs is a triangle-free class of graphs with arbitrarily large chromatic number. Since 1965, when Burling graphs were first introduced by Burling [Burling 1965], they have been useful in solving many problems in graph theory, specifically in the two fields of χ-boundedness and geometric graph theory. Meanwhile, they have been studied in many different ways: as intersection graphs of several different geometric objects and as subgraphs of an inductively defined sequence of graphs.

In this talk, after reviewing some applications of Burling graphs and recalling their classical definition, we see how to unify the previously existing views of Burling graphs by providing some new equivalent definitions. Moreover, we discuss how each of these definitions can be useful to obtain new results in graph theory, based on their respective features.

Paper 68:

Partitioning into degenerate graphs in linear time

Timothée Corsini, Quentin Deschamps, Carl Feghali, Daniel Gonçalves, Hélène Langlois and Alexandre Talon

Abstract: Let G be a connected graph with maximum degree $\Delta \geq 3$ distinct from $K_{\Delta+1}$. Generalizing Brooks' Theorem, Bollobás and Manvel proved that if $s_1, \ldots, s_t$ are non-negative integers such that $s_1 + \cdots + s_t \geq \Delta - t$, then G admits a vertex partition into parts $A_1, \ldots, A_t$ such that, for $1 \leq i \leq t$, $G[A_i]$ is s_i-degenerate. Here we show that such a partition can be performed in linear time. This generalizes previous results that treated subcases of a conjecture of Abu-Khzam, Feghali and Heggernes, which our result addresses in full.

Paper 69:

Towards Stahl's Conjecture: Multi-Colouring of Kneser Graphs

Jan van den Heuvel and **Xinyi Xu**

Abstract: If a graph is n-colourable, then it obviously is n'-colourable for any $n' \geq n$. But the situation is not so clear when we consider *multi-colourings* of graphs. A graph is (n,k)*-colourable* if we can assign each vertex a k-subset of $\{1,2,\ldots,n\}$, such that adjacent vertices receive disjoint subsets.

We consider the following problem: if a graph is (n,k)-colourable, then for what pairs (n',k') is it also (n',k')-colourable? This question can be translated into a question regarding multi-colourings of Kneser graphs, for which Stahl formulated a conjecture in 1976. We present new results and discuss some observations that lead to simple proofs of some known cases of the conjecture.

Paper 70:

Homomorphisms of (n,m)-graphs with respect to generalized switch

Sagnik Sen, Éric Sopena and S Taruni

Abstract: An (n,m)-graph has n different types of arcs and m different types of edges. A homomorphism of an (n,m)-graph G to an (n,m)-graph H is a vertex mapping that preserves adjacency type and directions. Notice that, in an (n,m)-graph a vertex can possibly have $(2n+m)$ different types of neighbors. In this article, we study homomorphisms of (n,m)-graphs while an Abelian group acts on the set of different types of neighbors of a vertex.

Paper 71:

On radio k-coloring of the power of the infinite path

Tapas Das, Tuomo Lehtilä, Soumen Nandi, Sagnik Sen and D K Supraja

Abstract: The radio k-chromatic number $rc_k(G)$ of a graph G is the minimum integer ℓ such that there is a mapping f from the vertices of G to the set of integers $\{0,1,\ldots,\ell\}$ satisfying $|f(u)-f(v)| \geq k+1-d(u,v)$ for any two distinct vertices $u,v \in V(G)$, where $d(u,v)$ denotes the distance between u and v. To date, the radio k-chromatic number is studied for finite and infinite paths, and their powers. In particular, lower and upper bounds exist for powers of infinite paths. In this article, we improve the known lower bound for the same. Specifically, when k is even, we halve the gap between the known lower and upper bounds.

Paper 72:

A generalization of Brussels sprouts

Zin Mar Myint, Soura Sena Das, Soumen Nandi, Sagnik Sen and Éric Sopena

Abstract: The Brussels sprout game is a two-player pen and paper game which has connections with the structural properties of planar graphs. We generalize the game for all hereditary graph classes and study it for the family of forests, graphs on orientable and non-orientable surfaces of genus ≥ 0, sparse planar graphs, etc. In the process, we also introduce a new game called Circular sprout and study it as a tool to solve problems on Brussels sprout.

Paper 73:

On counting orientations for graph homomorphisms and for dually embedded graphs using the Tutte polynomial of matroid perspectives

Emeric Gioan

Abstract: An (oriented) matroid perspective (or morphism, or strong map, or quotient) is an ordered pair of (oriented) matroids satisfying some structural relationship. In this presentation, we will focus on the case of graphs, where two notable types of perspectives can be considered: graph homomorphisms, and dually embedded graphs on a surface. The Tutte polynomial of such a perspective is a classical poly- nomial (also called Las Vergnas polynomial in the case of dually embedded graphs), whose coefficients and (some) evaluations are known to count pairs of orientations of certain types. In this presentation, we show how coefficients and (other) evaluations of the polynomial also count pairs of orientations of certain types where some edge orientations are fixed, as well as some equivalence classes of pairs of orientations of certain types. These properties appear when the edge set is linearly ordered.

Paper 74:

Certain extremal uniformly connected graphs

Tobias Hofmann and Frank Göring

Abstract: A graph is uniformly k-connected if each pair of its vertices is connected by exactly k independent paths. Building on a recent constructive characterization of uniformly 3-connected graphs, we reinvestigate a bound on the minimum number of vertices of minimum degree. We study the structure of those graphs that attain this bound and provide results about their crossing and chromatic numbers.

Paper 75:

Avoiding large squares in trees and planar graphs

Daniel Gonçalves, Pascal Ochem and Matthieu Rosenfeld

Abstract: The Thue number $\pi(G)$ of a graph G is the minimum number of colors needed to color G without creating a square on a path of G. For a graph class $\mathcal{C}$, $\pi(\mathcal{C})$ is the supremum of $\pi(G)$ over the graphs $G \in \mathcal{C}$. The Thue number has been investigated for famous minor-closed classes: $\pi(tree) = 4$, $7 \leq \pi(outerplanar) \leq 12$, and $11 \leq \pi(planar) \leq 768$. Following a suggestion of Grytczuk, we consider the generalized parameters $\pi_k(\mathcal{C})$ such that only squares of period at least k must be avoided. Thus, $\pi(\mathcal{C}) = \pi_1(\mathcal{C})$. We show that $\pi_5(tree) = 2$, $\pi_2(tree) = 3$, and $\pi_k(planar) \geq 11$ for every fixed k.

Paper 76:

Exactly Hittable Interval Graphs

Dhannya S M, Narayanaswamy N S and Nisha K K

Abstract: Given a set system (also well-known as a hypergraph) $H = \{\mathcal{U}, \mathcal{X}\}$, where $\mathcal{U}$ is a set of elements and $\mathcal{X}$ is a set of subsets of $\mathcal{U}$, an exact hitting set S is a subset of $\mathcal{U}$ such that each subset in $\mathcal{X}$ contains exactly one element in S. We refer to a set system as *exactly hittable* if it has an exact hitting set. In this paper, we study interval graphs which are the intersection graphs of set systems that are exactly hittable. We refer to these interval graphs as *exactly hittable interval graphs* (EHIG). We present a forbidden structure characterization for EHIG and also show that the class of proper interval graphs is a strict subclass of EHIG. Finally, we give an algorithm that runs in polynomial time to recognize graphs belonging to the class of EHIG.

Paper 77:

Making a tournament k-strong by adding new arcs

Jørgen Bang-Jensen, Kasper Skov Johansen and Anders Yeo

Abstract: A **semicomplete digraph** is a digraph with no pair of non-adjacent vertices and a **tournament** is a semicomplete digraph with no cycle of length 2.

We have proved that every semicomplete digraph on at least $k + 1$ vertices can be made k-strong by adding at most $\binom{k+1}{2}$ new arcs. This confirms a conjecture of Bang-Jensen from 1994.

Combined with other work, our results also imply that every tournament on at least $3k - 1$ vertices can be made k-strong by reversing at most $\binom{k+1}{2}$ arcs. This provides new support for the conjecture, due to Bang-Jensen, that we can make any tournament on at least $2k + 1$ vertices k-strong by reversing at most $\binom{k+1}{2}$ arcs.

Paper 78:

Generalized outerplanar Turán number of short paths

Addisu W. Paulos, Ervin Győri and Chuaqi Xiao

Abstract: Let H be a graph. The generalized outerplanar Turán number of H, denoted by $f_{\mathcal{OP}}(n, H)$, is the maximum number of copies of H in an n-vertex outerplanar graph. Let P_k denotes a path on k vertices. In this paper we give an exact value of $f_{\mathcal{OP}}(n, P_4)$ and a best asymptotic value of $f_{\mathcal{OP}}(n, P_5)$. Moreover, we characterize all outerplanar graphs containing $f_{\mathcal{OP}}(n, P_4)$ copies of P_4.

Paper 79:

Arc-disjoint out- and in-branchings with the same root in co-bipartite digraphs

Yun Wang and Jørgen Bang-Jensen

Abstract: A digraph is **semicomplete** if it has no pair of non-adjacent vertices. A digraph is **co-bipartite** if its vertex set can be partitioned in two sets V_1, V_2 such that $D\langle V_1\rangle$ and $D\langle V_2\rangle$ are semicomplete digraphs. An **out-branching** B_s^+ **(in-branching** B_s^-**)** of a digraph D is a spanning tree in the underlying graph of D whose edges are oriented in D such that every vertex except one, s, called the root, has in-degree (out-degree) one. Recently, Bang-Jensen et al. showed that every digraph of independence number at most 2 and arc-connectivity at least 2 has a pair of arc-disjoint out- and in-branchings and they conjectured that the same condition can guarantee such branchings with the same root s for any choice of $s \in V$. We resolved the conjecture in the affirmative for co-bipartite digraphs. The arc-connectivity and independent number bound in the conjecture is best possible in a sense.

Paper 80:

$(k-2)$-linear connected components in hypergraphs of rank k

Florian Galliot, Sylvain Gravier and Isabelle Sivignon

Abstract: We define a *q-linear path* in a hypergraph $\mathcal{H}$ as a sequence $(e_1, \ldots, e_L)$ of edges of $\mathcal{H}$ such that $|e_i \cap e_{i+1}| \in [\![1, q]\!]$ and $e_i \cap e_j = \emptyset$ if $|i-j| > 1$. In this paper, we study the connected components associated to these paths when $q = k-2$ where k is the rank of $\mathcal{H}$. If $k = 3$ then $q = 1$ which coincides with the well-known notion of *linear path* or *loose path*. We describe the structure of the connected components, using an algorithmic proof which shows that the connected components can be computed in polynomial time. A consequence of our algorithmic result is that tractable cases for the NP-complete problem of "Paths Avoiding Forbidden Pairs" in a graph can be deduced from the recognition of a special type of line graph of a hypergraph.

Paper 81:

Non-empty intersection of longest paths in H-free graphs

James A. Long Jr., Kevin G. Milans and Andrea Munaro

Abstract: We make progress toward a characterization of the graphs H such that every connected H-free graph has a longest path transversal of size 1. In particular, we show that the graphs H on at most 4 vertices satisfying this property are exactly the linear forests. We also show that if the order of a connected graph G is large relative to its connectivity $\kappa(G)$ and $\alpha(G) \leq \kappa(G) + 2$, then each vertex of maximum degree forms a longest path transversal of size 1.

Paper 82:

A Note on Generalized Majority Colorings

Grzegorz Gutowski, Marcin Anholcer, Bartłomiej Bosek, Jarosław Grytczuk, Jakub Przybyło and Mariusz Zając

Abstract: A *majority coloring* of a directed graph is a vertex coloring in which each vertex has the same color as at most half of its out-neighbors. In this note we simplify some proof techniques and generalize previously known results on various variants of majority coloring. In particular, our unified and simple approach gives the best known results for:

- directed and undirected graphs,
- $\frac{1}{k}$-majority colorings (each vertex has the same color as at most $\frac{1}{k}$ of its out-neighbors),
- weighted edges,
- list colorings (choosability),
- on-line list colorings (paintability),
- non-uniform list lengths,
- *ranked* colors.

Paper 83:

Polynomial characterization of the set of r-splits of a graph

François Pitois, Mohammed Haddad, Hamida Seba and Olivier Togni

Abstract: In this paper, we introduce r-splits, a generalization of graph splits. Splits are well-known graph cuts that allow representing a graph with a structure that can be described in linear space. We mainly prove that, analogously, r-splits can be described in polynomial space.

Paper 84:

The Ramsey number of square of paths

Domenico Mergoni, Peter Allen, Jozef Skokan and Barnaby Roberts

Abstract: The problem of finding explicit values of the Ramsey number $R(H,H)$ has been studied extensively, but the explicit value of $R(H,H)$ is known only for a few graphs H. Among the most relevant results in the area, Gerencsér and Gyárfás proved in 1967 that $R(P_{2n},P_{2n}) = 3n-1$, where P_{2n} is the path over $2n$ vertices.

We denote by P_{3n}^2 the square of the path over $3n$ vertices, which is the graph over $3n$ vertices obtained from P_{3n} by adding edges between vertices of distance 2. We prove that $R(P_{3n}^2,P_{3n}^2) = 9n-3$ for n large enough.

Paper 85:

Vizing's conjecture holds

Jonathan Narboni

Abstract: In 1964 Vizing proved that to properly color the edges of a graph G, one need at most $\Delta + 1$ colors, where Δ is the maximum degree of G. In his paper, Vizing actually proves that one can transform any proper edge coloring into a $(\Delta + 1)$-edge-coloring using only Kempe changes. Soon after his paper, he asked the following question: is an optimal edge-coloring always reachable from any proper edge-coloring using only Kempe changes? Bonamy & al. proved that the conjecture holds for triangle free graphs, following their work, we prove that it holds for all graphs.