Abstracts of KAM-DIMATIA Series
Year 2003

Dear colleagues,

in our experience as editors of KAM-DIMATIA Series we noticed, how many interesting submissions are going through our hands, much more than is possible to read by a mere human. To help people enjoy what is going on at KAM and DIMATIA in general, we prepared a list of abstracts of all papers submitted each year. We hope you will enjoy reading it.

Martin Bálek & Robert Šámal
editors of KAM-DIMATIA Series

2003-600 P. Hell and J.J. Montellano
Polychromatic Cliques

The sub-Ramsey number $sr(K_n, k)$ is the smallest integer m such that in any edge-colouring of K_m which uses every colour at most k times some subgraph K_n has all edges of different colours. It was known that, for a fixed k, the function $sr(K_n, k)$ is $O(n^3)$ and $\Omega(n)$. We improve these bounds to $O(n^2)$ and $\Omega(n^{3/2})$ (slightly less for small values of k).

2003-601 Z. Füredi, A.V. Kostochka, M. Stiebitz, R. Škrekovski, and D. B. West
Nordhaus–Gaddum-type theorems for decompositions into many parts

A *k-decomposition* $(G_1, \dots, G_k)$ of a graph G is a partition of its edge set to form k spanning subgraphs $G_1, \dots, G_k$. The classical theorem of Nordhaus and Gaddum bounds $\chi(G_1) + \chi(G_2)$ and $\chi(G_1)\chi(G_2)$ over all 2-decompositions of K_n. For a graph parameter p, let $p(k; G)$ denote the maximum of $\sum_{i=1}^{k} p(G_i)$ over all k-decompositions of the graph G.

The clique number ω, chromatic number χ, list chromatic number χ_ℓ, and Szekeres–Wilf number σ satisfy $\omega(2; K_n) = \chi(2; K_n) = \chi_\ell(2; K_n) = \sigma(2; K_n) = n+1$. We obtain lower and upper bounds for $\omega(k; K_n)$, $\chi(k; K_n)$, $\chi_\ell(k; K_n)$, and $\sigma(k; K_n)$. The last three behave differently for large k. We also obtain lower and upper bounds for the maximum of $\chi(k; G)$ over all graphs embedded on a given surface.

2003-602 V. Jungić, D. Král', and R. Škrekovski
Colorings of Plane Graphs with no Rainbow Faces

We prove that each n-vertex plane graph with girth $g \geq 4$ admits a vertex coloring with at least $\lceil n/2 \rceil + 1$ colors with no rainbow face, i.e., a face whose all vertices receive distinct colors. This answers in affirmative a conjecture of Ramamurthi and West. Moreover, we prove for plane graph with girth $g \geq 5$ that there is a vertex coloring with at least $\left\lceil \frac{g-3}{g-2} n - \frac{g-7}{2(g-2)} \right\rceil$ if g is odd and $\left\lceil \frac{g-3}{g-2} n - \frac{g-6}{2(g-2)} \right\rceil$ if g is even. The bounds are tight for all pairs of n and g with $g \geq 4$ and $n \geq 5g/2 - 3$.

2003-603 Z. Dvořák, J. Kára, D. Král', and O. Pangrác
An Algorithm for Cyclic Edge Connectivity of Cubic Graphs

The cyclic edge connectivity is the size of the smallest edge cut in a graph such that at least two of the parts of the graph are not acyclic. We present an algorithm running in time $O(n^2 \log^2 n)$ for computing the cyclic edge connectivity of n-vertex cubic graphs.

2003-604 M. Loebl
A Discrete Non-Pfaffian Approach to the Ising Problem

We describe a method developed in fifties by Kac, Ward, Potts, Feynman and Sherman to solve the 2-dimensional Ising problem using methods of discrete mathematics. This approach is older and not so well known to discrete mathematics community as the Pfaffian approach. Using the results of Sherman and the theory of Pfaffian orientations developed by Galluccio and Loebl we generalise the results to arbitrary (non-planar) graphs.

2003-605 B. Banaschewski and A. Pultr
On weak lattice and frame homomorphisms

In the context of distributive lattices, frames, or σ-frames, a join homomorphism preserving the unit and those binary meets which are zero often preserves all binary meets. This paper analyzes this phenomenon.

2003-606 J. Hubička and J. Nešetřil
On Homogeneous Graphs and Posets

We present a class $\mathcal{P}_{\in}$ of simple finite structures which induce the countable homogeneous universal poset. We also define the notion of a finitely presented countable structure and conjecture that every generic structure for a finitely axiomatizable class of structures is finitely presented. This is verified for undirected graphs, tournaments and posets. The structure $\mathcal{P}_{\in}$ extends Conway's surreal numbers and their linear ordering to posets.

2003-607 J. Matoušek
Bounded VC-dimension implies a fractional Helly theorem

We prove that every set system of bounded VC-dimension has a fractional Helly property. More precisely, if the dual shatter function of a set system $\mathcal{F}$ is bounded by $o(m^k)$, then $\mathcal{F}$ has fractional Helly number k. This means that for every $\alpha > 0$ there exists a $\beta > 0$ such that if $F_1, F_2, \ldots, F_n \in \mathcal{F}$ are sets with $\bigcap_{i \in I} F_i \neq \emptyset$ for at least $\alpha\binom{n}{k}$ sets $I \subseteq \{1, 2, \ldots, n\}$ of size k, then there exists a point common to at least βn of the F_i. This further implies a (p, k)-theorem: for every $\mathcal{F}$ as above and every $p \geq k$ there exists T such that if $\mathcal{G} \subseteq \mathcal{F}$ is a finite subfamily where among every p sets, some k intersect, then $\mathcal{G}$ has a transversal of size T. The assumption about bounded dual shatter function applies, for example, to families of sets in $\mathbf{R}^d$ definable by a bounded number of polynomial inequalities of bounded degree; in this case, we obtain fractional Helly number $d+1$.

2003-608 J. Han Kim, J. Matoušek, and V.H. Vu
Discrepancy after adding a single set

We show that the hereditary discrepancy of a hypergraph $\mathcal{F}$ on n points increases by a factor of at most $O(\log n)$ when one adds a new edge to $\mathcal{F}$.

2003-609 I. Bárány and J. Matoušek
The randomized integer convex hull

Let $K \subset \mathbf{R}^d$ be a sufficiently round convex body (the ratio of the circumscribed ball to the inscribed ball is bounded by a constant) of a sufficiently large volume. We investigate the *randomized integer convex hull* $I_L(K) = \mathrm{conv}(K \cap L)$, where L is a randomly translated and rotated copy of the integer lattice $\mathbf{Z}^d$. We estimate the expected number of vertices of $I_L(K)$, whose behaviour is similar to the expected number of vertices of the convex hull of $\mathrm{Vol}\, K$ random points in K. In the planar case, we also describe the expectation of the missed area $\mathrm{Vol}\,(K \setminus I_L(K))$. Surprisingly, for K a polygon, the behaviour in this case is different from the convex hull of random points.

2003-610 J. Matoušek and M. Stojaković
On Restricted Min-Wise Independence of Permutations

A family of permutations $\mathcal{F} \subseteq S_n$ with a probability distribution on it is called *k-restricted min-wise independent* if we have $\Pr[\min \pi(X) = \pi(x)] = \frac{1}{|X|}$ for every subset $X \subseteq [n]$ with $|X| \leq k$, every $x \in X$, and $\pi \in \mathcal{F}$ chosen at random. We present a simple proof of a result of Norin: every such family has size at least $\binom{n-1}{\lfloor \frac{k-1}{2} \rfloor}$. Some features of our method might be of independent interest.

The best available upper bound for the size of such family is $1+\sum_{j=2}^{k}(j-1)\binom{n}{j}$. We show that this bound is tight if the goal is to imitate not the uniform distribution on S_n, but a distribution given by assigning suitable priorities to the elements of $[n]$ (the stationary distribution of the *Tsetlin library*, or self-organizing lists). This is analogous to a result of Karloff and Mansour for k-wise independent random variables.

We also investigate the cases where the min-wise independence condition is required only for sets X of size *exactly* k (where we have only an $\Omega(\log\log n + k)$ lower bound), or for sets of size k and $k-1$ (where we already obtain a lower bound of $n-k+2$).

2003-611 J. Matoušek
A lower bound on the size of Lipschitz subsets in dimension 3

A set $S \subset \mathbf{R}^d$ is *C-Lipschitz in the x_i-coordinate*, where $C > 0$ is a real number, if for every two points $a, b \in S$, we have $|a_i - b_i| \leq C \max\{|a_j - b_j| : j = 1, 2, \ldots, d, j \neq i\}$. Motivated by a problem of Laczkovich, the author asked whether every n-point set in $\mathbf{R}^d$ contains a subset of size at least $cn^{1-1/d}$ that is C-Lipschitz in one of the coordinates, for suitable constants C and $c > 0$ (depending on d). This was answered negatively by Alberti, Csörnyei, and Preiss. Here it is observed that a combinatorial result of Ruzsa and Szemerédi implies the existence of a 2-Lipschitz subset of size $n^{1/2}\varphi(n)$ in every n-point set in $\mathbf{R}^3$, where $\varphi(n) \to \infty$ as $n \to \infty$.

2003-612 A. Holmsen and J. Matoušek
No Helly theorem for stabbing translates by lines in R^3

For each $n > 2$ we construct a convex body $K \subset \mathbb{R}^3$ and a finite family $\mathcal{F}$ of disjoint translates of K such that any $n-1$ members $\mathcal{F}$ admit a line transversal, but $\mathcal{F}$ has no line transversal.

2003-613 J. Matoušek
The number of unique-sink orientations of the hypercube

Let Q_d denote the graph of the d-dimensional cube. A *unique-sink orientation* (USO) is an orientation of Q_d such that every face of Q_n has exactly one sink (vertex of outdegree 0); it does not have to be acyclic. USO have been studied as an abstract model for many geometric optimization problems, such as linear programming, finding the smallest enclosing ball of a given point set, certain classes of convex programming, and certain linear complementarity problems. It is shown that the number of USO is $d^{\Theta(2^d)}$.

2003-614 D. Král'

Coloring Powers of Chordal Graphs

We prove that the k-th power G^k of a chordal graph G with maximum degree Δ is $O(\sqrt{k}\Delta^{(k+1)/2})$-degenerated for even values of k and $O(\Delta^{(k+1)/2})$-degenerated for odd ones. In particular, this bounds the chromatic number $\chi(G^k)$. The bound proven for odd values of k is the best possible. Another consequence is the bound $\lambda_{p,q}(G) \leq \left\lfloor \frac{(\Delta+1)^{3/2}}{\sqrt{6}} \right\rfloor (2q-1) + \Delta(2p-1)$ on the least possible span $\lambda_{p,q}(G)$ of an $L(p,q)$-labeling for chordal graphs G with maximum degree Δ. On the other hand, a construction of such graphs with $\lambda_{p,q}(G) \geq \Omega(\Delta^{3/2}q + \Delta p)$ is presented.

2003-615 P. Kolman and J. Matoušek

Crossing number, pair-crossing number, and expansion

The *crossing number* $\mathrm{cr}(G)$ of a graph G is the minimum possible number of edge crossings in a drawing of G in the plane, while the *pair-crossing number* $\mathrm{pcr}(G)$, introduced by Pach and Tóth, is the smallest number of pairs of edges that cross in a drawing of G in the plane. While $\mathrm{cr}(G) \geq \mathrm{pcr}(G)$ holds trivially, it is not known whether a strict inequality can ever occur. We aim at bounding $\mathrm{cr}(G)$ in terms of $\mathrm{pcr}(G)$. Using the methods of Leighton and Rao, Bhatt and Leighton, and Even, Guha and Schieber, we prove that $\mathrm{cr}(G) = O\big(\log^3 n(\mathrm{pcr}(G) + \mathrm{ssqd}(G))\big)$, where $n = |V(G)|$ and $\mathrm{ssqd}(G) = \sum_{v \in V(G)} \deg_G(v)^2$. One of the main steps is an analogy of the well-known lower bound $\mathrm{cr}(G) = \Omega(b(G)^2) - O(\mathrm{ssqd}(G))$, where $b(G)$ is the *bisection width* of G, that is, the smallest number of edges that have to be removed so that no component of the resulting graph has more than $\frac{2}{3}n$ vertices. We show that $\mathrm{pcr}(G) = \Omega(b(G)^2/\log^2 n) - O(\mathrm{ssqd}(G))$.

We also prove by similar methods that a graph G with $k = \mathrm{cr}(G) > C\sqrt{\mathrm{ssqd}(G)}\, m \log^2 n$ has a nonplanar subgraph on at most $O\big(\frac{\Delta n m \log^2 n}{k}\big)$ vertices, where m is the number of edges, Δ is the maximum degree in G, and C is a suitable sufficiently large constant.

2003-616 R.N. Ball, A. Pultr, and J. Sichler
Priestley configurations and Heyting varieties

We investigate Heyting varieties determined by prohibition of systems of configuraations in Priestley duals; we characterize the configuration systems yielding such varieties. On the other hand, the question whether a given finitely generated Heyting variety is obtainable by such means is solved for the special case of systems of trees.

2003-617
Oficiál Kombinatorického semináře (J. Fiala, ed.)

2003-618 M. Loebl, J. Matoušek, and O. Pangrác
Triangles in random graphs

We show the number of triangles of $G_{n,\frac{1}{2}}$ is almost uniformly distributed among residue classes modulo q, where q is a prime number bounded by $\Theta(\log n)$. This implies a consequence of a conjecture of Bollobás, Pebody and Riordan (that almost every random graph $G_{n,\frac{1}{2}}$ is uniquely determined by its Tutte polynomial): almost every pair of independently chosen random graphs $G_{n,\frac{1}{2}}$ has different Tutte polynomials.

2003-619 T. Luczak, J. Nešetřil
On projective graphs

We show that all graphs with a simple extension property are projective. As a consequence of this result we settle in the affirmative a conjecture of Larose and Tardif and characterize all homogeneous graphs which are projective.

2003-620 J. Hubička, J. Nešetřil
Universal Partial Order Represented by Means of Trees and Other Simple Graphs

We present several simple representations of universal partially ordered sets and use them for the proof of universality of the class of oriented trees ordered by the graph homomorphisms. This (what we believe surprising result) solves several open problems. It implies for example universality of cubic planar graphs. This is in sharp contrast with representing even groups (and monoids) by automorphisms (and endomorphims) of a bounded degree and planar graph. Thus universal partial orders (thin categories) are representable by much simpler structures than categories in general.

2003-621 J. Hubička, J. Nešetřil

Finite Paths are Universal

We prove that any countable (finite or infinite) partially ordered set may be represented by finite oriented paths ordered by the existence of homomorphism between them. This (what we believe a surprising result) solves several open problems. Such path-representations were previously known only for finite and infinite partial orders of dimension 2. Path-representation implies the universality of other classes of graphs (such as connected cubic planar graphs). It also implies that finite partially ordered sets are on-line representable by paths and their homomorphisms. This leads to a new on-line dimensions.

2003-622 J. Fiala, J. Maxová

Cantor-type theorem for locally constrained graph homomorphisms

In the paper we show that the simultaneous existence of a locally surjective and of a locally injective graph homomorphisms between a connected graph G and a connected and finite graph H assures that all such homomorphisms are in fact locally bijective.

We give a short proof of this assertion which unifies previously known partial results of this form. We utilize the notion of universal cover, and relate its properties to the notion of degree refinement, which was used as a principal tool in other works.

2003-623 J. Černý, Z. Dvořák, V. Jelínek, and P. Podbrdský

Generalization of the polygon-crossing problem

We study the maximum possible number of intersections of a simple k–gon with a simple l–gon for $k, l \geq 3$ odd. We generalize this problem to a larger class of objects. We prove that the number of intersections cannot exceed $kl - k - (l-3)/2$. This improves the best known upper bound and gives alternative solution of the case $l = 5$.

2003-624 M. Bodirsky and J. Nešetřil
Constraint Satisfaction with Countable Homogeneous Templates

For a fixed countable homogeneous structure Γ we study the computational problem whether a given finite structure of the same relational signature homomorphically maps to Γ. This problem is known as the constraint satisfaction problem CSP(Γ) for Γ and was intensively studied for finite Γ. We show that - as in the case of finite Γ - the computational complexity of CSP(Γ) for countable homogeneous Γ is determinded by the clone of polymorphisms of Γ. To this end we prove the following theorem which is of independent interest: The primitive positive definable relations over an ω-categorical structure Γ are precisely the relations that are invariant under the polymorphisms of Γ.

Constraint satisfaction with countable homogeneous templates is a proper generalization of constraint satisfaction with finite templates. If the age of Γ is finitely axiomatizable, then CSP(Γ) is in NP. If Γ is a digraph we can use the classification of homogeneous digraphs by Cherlin to determine the complexity of CSP(Γ).

2003-625 M. Bálek and J. Nešetřil
Measuring of Aesthetic Invariant of Images

We define four new aesthetics — Combinatorial Entropies — for graph drawings, sketches and images and show their relevance for picture processing by means of results of integral geometry. We include an analysis of two pictures.

2003-626 Daniel Král'
Locally satisfiable formulas

A CNF formula ψ is k-satisfiable if each k clauses of ψ can be satisfied simultaneously. Let π_k be the largest real number such that for each k-satisfiable formula ψ with variables x_i, there are probabilities p_i with the following property: If each variable x_i is chosen randomly and independently to be true with the probability p_i, then each clause of ψ is satisfied with the probability at least π_k.

We determine the numbers π_k and design a linear-time algorithm which given a formula ψ either outputs that ψ is not k-satisfiable or finds probabilities p_i such that each clause of ψ is satisfied with the probability at least π_k. Our approach yields a robust linear-time deterministic algorithm which finds for a k-satisfiable formula a truth assignment satisfying at least the fraction of π_k of the clauses.

A related parameter is r_k which is the largest ratio such that for each k-satisfiable CNF formula with m clauses, there is a truth assignment which satisfies at least $r_k m$ of its clauses. It was known that $\pi_k = r_k$ for $k = 1, 2, 3$. We compute the ratio r_4 and show $\pi_4 \neq r_4$. We also design a linear-time algorithm which finds a truth assignment satisfying at least the fraction r_4 of the clauses for 4-satisfiable formulas.

2003-627 J. Černý, Z. Dvořák, V. Jelínek, J. Kára
Noncrossing Hamiltonian Paths in Geometric Graphs

A geometric graph is a graph embedded in the plane in such a way that vertices correspond to points in general position and edges to segments connecting appropriate points. A noncrossing Hamiltonian path is a Hamiltonian path whose embedding in the plane is a simple curve in the plane. We study the problem asked by Micha Perles about the existence of a noncrossing Hamiltonian path for various classes of geometric graphs. Let $h_1(n)$ denote the largest k such that when we remove edges of an arbitrary complete subgraph of size at most k from a complete geometric graph on n vertices the resulting graph still has a noncrossing Hamiltonian path. We prove that there exist constants $0 < c_1 < c_2$ such that $c_1 \cdot \sqrt{n} < h_1(n) < c_2 \cdot \sqrt{n}$. Let $h_2(n)$ denote the largest k such that when we remove an arbitrary star with at most k edges from a complete geometric graph on n vertices the resulting graph still has a noncrossing Hamiltonian path. We show that $h_2(n) = \lceil n/2 \rceil - 1$. We also prove that $h_3(n) = \lceil n/2 \rceil - 1$ where $h_3(n)$ is the largest k such that when we remove at most k arbitrary edges from a complete geometric graph on n vertices whose vertices are in convex position then the graph still has a noncrossing Hamiltonian path. Further we prove that when we remove any matching from a complete geometric graph the resulting graph will have a noncrossing Hamiltonian path.

2003-628 B. Brešar, S. Klavžar, and R. Škrekovski
On cube-free median graphs

Let G be a cube-free median graph. It is proved that $\frac{k}{2} \geq \sqrt{n} - 1 \geq \frac{m}{2\sqrt{n}} \geq \sqrt{s} \geq r - 1$, where n, m, s, k, and r are the number of vertices, edges, squares, Θ-classes, and the number of edges in a smallest Θ-class of G, respectively. Moreover, the equalities characterize Cartesian products of two trees of the same order. The cube polynomial of cube-free median graphs is also considered and it is shown that planar cube-free median graphs can be recognized in linear time.

2003-629 J. Kratochvíl

Complexity of hypergraph coloring and Seidel's switching

Seidel's switching of a vertex in a given graph results in making the vertex adjacent to precisely those vertices it was nonadjacent before, while keeping the rest of the graph unchanged. Two graphs are called switching equivalent if one can be transformed into the other one by a sequence of Seidel's switchings. We consider the computational complexity of deciding if an input graph can be switched into a graph having a desired graph property. Among other results we show that switching to a regular graph is NP-complete. The proof is based on an NP-complete variant of hypergraph bicoloring that we find interesting in its own.

2003-630 H. Broersma, F.V. Fomin, J. Kratochvíl, and G. J. Woeginger

Planar graph coloring avoiding monochromatic subgraphs: trees and paths make things difficult

We consider the problem of coloring a planar graph with the minimum number of colors such that each color class avoids one or more forbidden graphs as subgraphs. We perform a detailed study of the computational complexity of this problem.

We present a complete picture for the case with a single forbidden connected (induced or non-induced) subgraph. The 2-coloring problem is NP-hard if the forbidden subgraph is a tree with at least two edges, and it is polynomially solvable in all other cases. The 3-coloring problem is NP-hard if the forbidden subgraph is a nontrivial path, and it is polynomially solvable in all other cases. We also derive results for several forbidden sets of cycles.

2003-631 S. Gravier and R. Škrekovski

Coloring the clique hypergraph of graphs without forbidden structure

For a given simple connected graph G with at least one edge, the clique hypergraph is defined as the one with the same vertex set as G but whose hyperedges are the maximal cliques of G. We characterize that C_5 is the only graph without induced P_3+P_1, whose clique hypergraph is not 2-colorable. We prove also that the clique hypergraph is 2-colorable providing that the underlined graph is without induced P_5 and C_5. The later result is best possible in the sense that if we omit some of the forbidden graphs, then the claim is not true.

2003-632 V. Jungić and R. Radoičić
Rainbow Arithmetic Progressions

Consider a coloring of $\{1, 2, \ldots, n\}$ in 3 colors, where $n \equiv 0 \pmod 3$. If all the color classes have the same cardinality, then there is a 3-term arithmetic progression whose elements are colored in distinct colors. This rainbow variant of van der Waerden's theorem proves the conjecture of the second author.

2003-633 D. Král' and L. Stacho
Closure for the Property of Having a Hamiltonian Prism

We prove that a graph G of order n has a hamiltonian prism if and only if the graph $\mathrm{Cl}_{4n/3-4/3}(G)$ has a hamiltonian prism where $\mathrm{Cl}_{4n/3-4/3}(G)$ is the graph obtained from G by sequential adding edges between non-adjacent vertices whose degree sum is at least $4n/3-4/3$. We show that this cannot be improved to more than $4n/3-5$.

2003-634 M. Stiebitz and R. Škrekovski
A Map Colour Theorem for the Union of Graphs

In 1890 Heawood established an upper bound for the chromatic number of a graph embedded on a surface of Euler genus $g \geq 1$. This upper bound becomes known as the Heawood number $H(g)$. Almost a century later, Ringel and Ringel & Youngs proved that the Heawood number $H(g)$ is in fact the maximum chromatic number as well as the maximum clique number of graphs embbeded on a surface of Euler genus $g \geq 1$ beside the Klein bottle. In this paper we present a Heawood type formula for the edge disjoint union of two graphs that are embedded on a given surface Σ. More precisely, we determine a number $H_2(\Sigma)$ such that if a graph G embedded on Σ is the edge disjoint union of two graphs G_1 and G_2, then

$$\omega(G_1) + \omega(G_2) \leq \chi(G_1) + \chi(G_2) \leq H_2(\Sigma).$$

Similar to the results of Ringel and Ringel & Youngs, we show that this bound is sharp for all but at most one non-orientable surface Σ.

2003-635 J. Matoušek and P. Škovroň

Three views of LP-type optimization problems

An axiomatically defined class of optimization problems, called *LP-type problems* (or also *generalized linear programming problems*) and introduced by Sharir and Welzl, includes linear programming, the smallest enclosing ball for a given point set in $\mathbf{R}^d$, and many other important problems. We investigate mathematical properties of LP-type problems. In particular, we introduce two axiomatic definitions, the *concrete LP-type problems* and the *acyclic violator spaces*, and we show that they are exactly equivalent to the original definition, thus providing two new approaches to LP-type problems.

2003-636 T. Kaiser and D. Král' and R. Škrekovski

A Revival of the Girth Conjecture

We show that for each $\varepsilon > 0$, there exists a number g such that the circular chromatic index of every cubic bridgeless graph with girth at least g is at most $3 + \varepsilon$. This contrasts to the fact (which disproved the Girth Conjecture) that there are snarks of arbitrary large girth. In particular, we show that every cubic bridgeless graph with girth at least 14 has the circular chromatic index at most 7/2.

2003-637 D. Král'

Extending partial 5-colorings and 6-colorings in planar graphs

Let D be a disc and let X be a finite set of points on the boundary of D. A set C of k-colorings of the points X is called k-feasible if there exists a plane graph G drawn in the disc D with $X \subseteq V(G)$ such that precisely colorings contained in the set C can be extended to proper colorings of G. We show that for each k-feasible set C, there exists such a plane graph G of order at most $|X| + 5^{|X|}$ if $k = 5$ and $17|X| - 48$ if $k = 6$.

2003-638 M. Janata

Matroids Induced by Packing Subgraphs

The paper is concerned with the classification of families of graphs $\mathcal{T}$ with the property: For any graph G, the subsets of vertices of G that can be saturated by packing copies of graphs from $\mathcal{T}$ form a collection of independent sets of a matroid. From this point of view, we present a characterization of so called EHP-families of graphs (i.e families consisting of K_2, hypomatchable graphs and propellers). The main result is the following: For a matroid-inducing EHP-family $\mathcal{T}$, we characterize connected graphs H such that the family $\mathcal{T} \cup \{H\}$ is also matroid-inducing.

2003-639 M. Janata
About a new class of matroid-inducing packing families

Let $\mathcal{T}$ be a family of graphs. A $\mathcal{T}$-packing of a graph G is a set of disjoint subgraphs of G, each isomorphic to one of the members of $\mathcal{T}$. We are concerned with families $\mathcal{T}$, such that in every graph G, the subsets of vertices that can be saturated by some $\mathcal{T}$-packing form a collection of independent sets of a matroid. The main purpose of this paper is to introduce a new class of families with this property.

2003-640 T. Luczak and J. Nešetřil
A probabilistic approach to the dychotomy problem

Let $\mathcal{R}(n,k)$ denote the random k-ary relation defined on the set $[n] = \{1,2,\ldots,n\}$. We show that the probability that $([n],\mathcal{R}(n,k))$ is projective tends to one, as either n or k tends to infinity. This result implies that for most relational systems $(B,\underline{R})$ the $\mathrm{CSP}(B,\underline{R})$ problem is NP-complete, and confirms a conjecture of Rosenberg.

2003-641 D. Král and J. Sgall
Coloring graphs from lists with bounded size of their union

A graph G is k-choosable if its vertices can be colored from any lists $L(v)$ of colors with $|L(v)| \geq k$ for all $v \in V(G)$. A graph G is said to be (k,u)-choosable if its vertices can be colored from any lists $L(v)$ with $|L(v)| \geq k$, for all $v \in V(G)$, and with $|\bigcup_{v\in V(G)} L(v)| \leq u$. For each $3 \leq k \leq u$, we construct a graph G which is (k,u)-choosable but not $(k,u+1)$-choosable. On the other hand, it is proven that each $(k,2k-1)$-choosable graph G is $O(k \cdot \ln k \cdot 2^{4k})$-choosable.

2003-642 J. Nešetřil and O. Serra
The Erdos-Turán Property for a Class of Bases

Given a set A of positive integers, $r_A(n)$ denotes the number of representations of n as a sum of two elements in A. It was conjectured by Erdős and Turán in 1942 that, if A is an asymptotic basis of order 2, then $\limsup_{n\to\infty} r_A(n) = \infty$. A set $A \subset \mathbb{N}$ is 2-bounded if there is a function f such that, for each $n \in A + A$ there is a pair $x, y \in A$ such that $n = x + y$ and $|S(x) \cup S(y)| \leq f(|S(n)|)$ where $S(n)$ denotes the binary support of n, that is, $n = \sum_{i\in S(n)} 2^i$. We prove the Erdős-Turán conjecture for any 2-bounded asymptotic basis of order $h \geq 2$. We list several other variations and strengthenings of this conjecture and we highlight the differences between versions for integers and positive integers, and additive and multiplicative versions.

2003-643 J. Nešetřil
Ramsey Classes and Homogeneous Structures

We present a programme of characterizing Ramsey Classes of Structures by a combination of the Model Theory and Combinatorics. Particularly we relate the Classification Programme of countable homogeneous structures (of Lachlan – Cherlin) to the Classification of Ramsey classes. As particular instances of this approach we characterize all Ramsey classes of graphs, tournaments and partial ordered sets. We fully characterize all monotone Ramsey classes of relational systems (of any type). We also carefully discuss the role of (admissible) orderings which lead to a new classification of Ramsey properties by means of classes of order invariant objects.

2003-644 W. Hochstättler and J. Nešetřil
Antisymmetric Flows in Matroids

We present a seemingly new definition of flows and flow numbers for oriented matroids and prove that the *flow number* $\Phi_{\mathcal{L}}$ and the *antisymmetric flow number* $\Phi_{\mathcal{L}as}$ of an oriented matroid are bounded with its rank. In particular we show that if $\mathcal{O}$ is an oriented matroid of rank r then $\Phi_{\mathcal{L}}(\mathcal{O}) \leq r + 2$ and $\Phi_{\mathcal{L}as}(\mathcal{O}) \leq 3^{\lfloor \frac{9}{2} r\rfloor + 1}$.

Furthermore, we introduce the notion of a semiflow and show that each oriented matroid has an antisymmetric 3-NZ-semiflow.

2003-645 D. Král'

Mixed Hypergraphs and Other Coloring Problems

A mixed hypergraph is a triple $(V, \mathcal{C}, \mathcal{D})$ where V is the vertex set and $\mathcal{C}$ and $\mathcal{D}$ are sets of subsets of V called $\mathcal{C}$-edges and $\mathcal{D}$-edges, respectively. A proper coloring of a mixed hypergraph $(V, \mathcal{C}, \mathcal{D})$ is a coloring of its vertices such that no $\mathcal{C}$-edge is polychromatic and no $\mathcal{D}$-edge is monochromatic. We show that mixed hypergraphs can be used to efficiently model several graph coloring problems including homomorphisms of simple graphs and multigraphs, circular colorings, $(H, C, \leq K)$-colorings, (H, C, K)-colorings, locally surjective, locally bijective and locally injective homomorphisms, $L(p, q)$-labelings, the channel assignment problem, T-colorings and generalized T-colorings.

2003-646 T. Madaras and R. Škrekovski

Lightness, heaviness and gravity

The gravity $g(H, \mathcal{H})$ of a graph H in the family of graphs $\mathcal{H}$ is the greatest integer n with the property that for every integer m, there are infinitely many graphs $G \in \mathcal{H}$ such that each subgraph of G, which is isomorphic to H, contains at least n vertices of degree $\geq m$ in G. We study the basic properties of the gravity function for various families of plane graphs. We also introduce and study the almost-light graphs and the absolutely heavy graphs. The paper concludes with few open problems.

2003-647 J. Fiala, D. Král' and R. Škrekovski

A Brooks-type Theorem for the Generalized List T-Coloring

We study the notion of a generalized list T-coloring which is a common generalization of the channel assignment problem and the T-coloring. An instance of the generalized list T-coloring is described by a triple (G, Λ, t) where G is a graph, Λ is a mapping which assigns the vertices of G lists of numbers (colors) and t is a mapping which assigns each edge of G a set of forbidden differences. We require that $0 \in t(e)$ for each edge e of G. The goal is to find a labeling c of the vertices of G with $c(v) \in \Lambda(v)$ for each vertex v, and $|c(u) - c(v)| \notin t(uv)$ for each edge uv of G. An instance is balanced if the size of the list $\Lambda(v)$ for each vertex v is equal to the sum of the sizes of $t(e)$ for edges e incident with v.

We state and prove a Brooks-type theorem for the generalized list T-coloring problem. This generalizes and unifies the previously known Brooks-type theorems for the channel assignment problem and for the T-coloring. The theorem characterizes balanced instances of the generalized list T-coloring with a good labeling. As a consequence, if G is a connected graph different from a Gallai tree, then all balanced instances on G have good labelings.

2003-648 D. Král'
Group coloring is Π_2^P-complete

The group chromatic number of a graph G is the smallest integer k such that for each Abelian group A of order at least k, each orientation of G and each edge-labeling $\varphi : E(G) \to A$, there exists a vertex-coloring $c : V(G) \to A$ with $c(v) - c(u) \neq \varphi(uv)$ for all oriented edges uv of G. We show that the decision problem whether a given graph has group chromatic number at most k is Π_2^P-complete for each integer $k \geq 3$.

2003-649 J. Černý
Geometric graphs with no three disjoint edges

A *geometric graph* is a graph drawn in the plane so that the vertices are represented by points in general position and edges are represented by straight line segments. We show that a geometric graph on n vertices with no three pairwise disjoint edges has at most $2.5n + 1$ edges. This result is tight up to a constant.

2003-650 R. N. Ball, A. Pultr and J. Sichler
Configurations in Coproducts of Priestley Spaces

Let P be a configuration, i.e., a finite poset with top element. Let $\mathsf{Forb}(P)$ be the class of bounded distributive lattices L whose Priestley space $\mathcal{P}(L)$ contains no copy of P. We show that the following are equivalent: $\mathsf{Forb}(P)$ is first-order definable, i.e., there is a set of first-order sentences in the language of bounded lattice theory whose satisfaction characterizes membership in $\mathsf{Forb}(P)$; P is coproductive, i.e., P embeds in a coproduct of Priestley spaces iff it embeds in one of the summands; P is a tree. In the restricted context of Heyting algebras, these conditions are also equivalent to $\mathsf{Forb}_H(P)$ being a variety, or even a quasivariety.

2003-651 J. Nešetřil, A. Pultr and C. Tardif
Gaps and dualities in Heyting categories

We present an algebraic treatment of the correspondence of gaps and dualities in partial ordered classes induced by the morphism structures of certain categories which we call Heyting (such are for instance all cartesian closed categories, but we present examples of others, too). This allows to extend the results of Nešetřil and Tardif to a wide range of more general structures. Also, we introduce a notion of combined dualities and discuss the relation of their structure to that of the plain ones.

2003-652 T. H. Marshall
Antisymmetric flows on planar graphs

We prove that every oriented planar graph admits a homomorphism to the Paley tournament $P(271)$ and hence that every oriented planar graph has an antisymmetric flow number and a strong oriented chromatic number of at most 271.

2003-653 B. Gärtner, F. Tschirschnitz, J. Solymosi,
P. Valtr and E. Welzl
One line and n points

We analyze a randomized pivoting process involving one line and n points in the plane. The process models the behavior of the Random-Edge simplex algorithm on simple polytopes with n facets in dimension $n-2$. We obtain a tight $O(\log^2 n)$ bound for the expected number of pivot steps. This is the first nontrivial bound for Random-Edge which goes beyond bounds for specific polytopes. The process itself can be interpreted as a simple algorithm for certain 2-variable linear programming problems, and we prove a tight $\Theta(n)$ bound for its expected runtime.
