Abstracts of KAM-DIMATIA Series
Year 2002

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

2002-545 D. Král'

On Maximum Face-Constrained Coloring of Plane Graphs of Girth at least 5

We prove that each plane graph of girth at least five on $n \geq 4$ vertices can be colored by at least $\lceil n/2 \rceil + 1$ colors in such a way that it does not contain a multicolored face, i.e. the face whose all the vertices have mutually distinct colors.

2002-546 M. Loebl, J. Nešetřil, and B. Reed

A Note on Random Homomorphism from Arbitrary Graphs to $\mathbb{Z}$

We discuss the space of mappings f from the vertices of a fixed graph G to $\mathbb{Z}$ which satisfy: $|f(u) - f(v)| \leq 1$ whenever $uv \in E(G)$. In particular we focus on the (random) range of such mappings.

2002-547 D. Král'

A Counter-Example to Voloshin's Hypergraph Co-perfectness Conjecture

The upper chromatic number $\overline{\chi}(H)$ of a hypergraph H is the maximum number of colors in a coloring avoiding a polychromatic edge. The stability number $\alpha(H)$ of a hypergraph H is the cardinality of the largest set of vertices of H which does not contain an edge. A hypergraph is k–uniform if the sizes of all its edges are k. A hypergraph H is co–perfect if $\overline{\chi}(H') = \alpha(H')$ for each induced subhypergraph H' of H.

Voloshin conjectured that an r–uniform hypergraph H ($r \geq 3$) is co–perfect iff it contains neither of two special r–uniform hypergraphs (a so–called monostar and a complete circular r–uniform hypergraph on $2r-1$ vertices) as an induced subhypergraph. We disprove this conjecture for all r's.

2002-548 Z. Dvořák, J. Kára, D. Král', and O. Pangrác

On Pattern Coloring of Cycle Systems

A k–cycle system is a system of cyclically ordered k–tuples of a finite set. A pattern is a sequence of letters. A coloring of a k–cycle system with respect to a set of patterns of length k is proper iff each cycle is colored consistently with one of the patterns, i.e. the same/distinct letters correspond to (the) same/distinct color(s). The feasible set of a cycle system is the set of all l's such that there exists a proper coloring of it using exactly l colors.

For all combinations of a pattern set $\mathcal{P}$ and a number l, we either find a polynomial algorithm or prove NP–completeness of the problem whether a given cycle system with a set of patterns $\mathcal{P}$ can be colored by at most l colors. We further construct a cycle system with a prescribed feasible set for almost every set of patterns containing only two different letters.

2002-549 D. Král', J. Kratochvíl, A. Proskurowski, and H.-J. Voss
Mixed Hypertrees

A mixed hypergraph is a triple $(V, \mathcal{C}, \mathcal{D})$ where V is its vertex set and $\mathcal{C}$ and $\mathcal{D}$ are families of subsets of V, $\mathcal{C}$–edges and $\mathcal{D}$–edges. We demand in a proper coloring that each $\mathcal{C}$–edge contains two vertices with the same color and each $\mathcal{D}$–edge contains two vertices with different colors. The feasible set of a mixed hypergraph is the set of all k's for which there exists a proper coloring using exactly k colors. A hypergraph is a hypertree if there exists a tree such that the edges of the hypergraph induce connected subgraphs of that tree.

We prove that feasible sets of mixed hypertrees are gap–free, i.e., intervals of integers, and we show that this is not true for precolored mixed hypertrees. The problem to decide whether a mixed hypertree can be colored by k colors is NP–complete in general; we investigate complexity of various restrictions of this problem and we characterize their complexity in most of the cases.

2002-550 M. Mareš
Two Linear Time Algorithms for MST on Minor Closed Graph Classes

This article presents two simple deterministic algorithms for finding the Minimum Spanning Tree in $O(|V| + |E|)$ time for any proper class ofgraphs closed on graph minors, which includes planar graphs and graphs of bounded genus. Both algorithms require no a priori knowledge of the structure of the class except for its density; edge weights are only compared and no random access to data is needed.

2002-551 R. Šámal
Antisymmetric Flows and Strong Oriented Coloring of Planar Graphs

In a recent paper Nešetřil and Raspaud defined antisymmetric flow, which is a variant of nowhere zero flow, and the dual notion to strong oriented coloring. We give an upper bound on the number of colors needed to a strong oriented coloring of a planar graph, and hereby we find a small antisymmetric flow for any planar graph. In the proof we use a result from combinatorial number theory—existence of large Sidon sets.

2002-552 T. Erlebach, and J. Fiala
On-line Coloring of Geometric Intersection Graphs

This paper studies on-line coloring of geometric intersection graphs. It is shown that no deterministic on-line algorithm can achieve competitive ratio better than $\Omega(\log n)$ for disk graphs and for square graphs with n vertices, even if the geometric representation is given as part of the input. Furthermore, it is proved that the standard First-fit heuristic achieves competitive ratio $O(\log n)$ for disk graphs and for square graphs and is thus best possible.

2002-553 E. Specker
Postmoderní matematika: Rozloučení s rájem? Logika aneb umění programování (ed. J. Nešetřil)

44. KAM Matematické kolokvium přednesl dne 5. března 2002 prof. dr. Ernst Specker. Jeho osobnost je představena krátce v pozvánce ke kolokviu. Protože se jedná o mimořádnou událost, KAM a ITI s laskavým svolením přednášejícího vydaly vzpomínkovou publikaci, která zahrnuje české překlady jeho článků Postmoderne Matematik: Abschied vom Paradises? a Die Logik oder Die Kunst des Programmierens. Obě vyšly v Ernst Specker: Selecta (ed. G. Jäger, H. Läuchli, B. Scarpellini, V. Strassen), Birkhäuser Verlag, 1990; Děkuji Ernstovi Speckerovi za laskavé poskytnutí podkladů a dr. M. Klazarovi, H. Nyklové, R. Bartákovi a J. Hubičkovi za pomoc s tímto číslem KAM-DIMATIA Serií.

2002-554 S. Garoufalidis, and M. Loebl
Random Walks and the Colored Jones Function

It can be conjectured that the colored Jones function of a knot can be computed in terms of counting paths on the graph of a planar projection of a knot. On the combinatorial level, the colored Jones function can be replaced by its weight system. We give two curious formulas for the weight system of a colored Jones function: one in terms of the permanent of a matrix associated to a chord diagram, and another in terms of counting paths of intersecting chords.

2002-555 B. Eckmann
Vzpomínky na Heinze Hopfa
(Proslov přednesený 4.12.2001 u příležitosti Hopfovy přednášky)
(ed. J. Nešetřil)

45. KAM Matematické kolokvium přednesl dne 23. dubna 2002 prof. dr. Beno Eckmann. Jeho osobnost je představena krátce v pozvánce ke kolokviu. Protože se jedná o mimořádnou událost, KAM a ITI s laskavým svolením přednášejícího vydaly tuto publikaci, která zahrnuje český překlad vzpomínkového proslovu u příležitosti obnovení Hopfových přednášek na ETH Curych dne 4. prosince 2001. Proslov je věnován osobnosti Heinze Hopfa, který byl učitelem prof. Eckmanna. Překlad přednášky vychází zde poprvé (v překladu H. Marxové) s laskavým svolením autora, který rovněž poskytl fotografii Heinze Hopfa. Děkuji prof. Eckmannovi, a rovněž dr. M. Klazarovi, J. Hubičkovi a R. Šámalovi za pomoc s tímto číslem KAM–DIMATIA serií.

2002-556 J. Fiala, K. Jansen, V.B. Le, and E. Seidel
Graph Subcolorings: Complexity and Algorithms

In a graph coloring, each color class induces a disjoint union of isolated vertices. A graph subcoloring generalizes this concept, since here each color class induces a disjoint union of complete graphs. Erdős and independently Albertson et al. proved that every graph of maximum degree at most 3 has a 2-subcoloring. We point out in this paper that this fact is best possible with respect to degree-constraints by showing that the problem of recognizing 2-subcolorable graphs with maximum degree 4 is *NP*-complete, even when restricted to triangle-free planar graphs. Moreover, in general, for fixed k, recognizing k-subcolorable graphs is *NP*-complete on graphs with maximum degree at most k^2. In contrast, we show that, for arbitrary k, k-Subcolorability can be computed efficiently on graphs of bounded treewidth, on cographs and on graphs with bounded cliquewidth.

2002-557 J. Fiala, P. Heggernes, P. Kristiansen, and J.A. Telle
Generalized H-coloring and H-covering of Trees

We study $H(p,q)$-colorings of graphs, for H a fixed simple graph and p,q natural numbers, a generalization of various other vertex partitioning concepts such as H-covering. An H-cover of a graph G is a local isomorphism between G and H, and the complexity of deciding if an input graph G has an H-cover is still open for many graphs H. In this paper we show that the complexity of $H(2p, q)$-COLORING is directly related to these open graph covering problems, and answer some of them by resolving the complexity of $H(p, q)$-COLORING for all acyclic graphs H and all values of p and q.

2002-558 P. Potočnik and R. Škrekovski
Nowhere-zero 3-flows in Cayley graphs of Abelian groups

We characterize Cayley graphs of abelian groups which admit a nowhere-zero 3-flow. In particular, we prove that every k-valent Cayley graph of an abelian group, where $k \geq 4$, admits a nowhere-zero 3-flow.

2002-559 D. Král' and H.-J. Voss
Edge–Disjoint Odd Cycles in Planar Graphs

We prove $\tau_{\text{odd}}(G) \leq 2\nu_{\text{odd}}(G)$ for each planar graph G where $\nu_{\text{odd}}(G)$ is the maximum number of edge–disjoint odd cycles and $\tau_{\text{odd}}(G)$ is the minimum number of edges whose removal makes G to be bipartite, i.e. which meet all the odd cycles. For each k, there is a 3–connected planar graph G_k with $\tau_{\text{odd}}(G) = 2k$ and $\nu_{\text{odd}}(G) = k$.

2002-560 J. Díaz, J. Nešetřil, M. Serna, D. M. Thilikos
H-colorings of Large Degree Graphs

We consider the H-coloring problem on graphs with vertices of large degree. We prove that for H an odd cycle, the problem belongs to P. We also study the phase transition of the problem, for an infinite family of graphs of a given chromatic number, i.e. the threshold density value for which the problem changes from P to NP-complete. We extend the result for the case that the input graph has a logarithmic size of small degree vertices. As a corollary, we get a new result on the chromatic number; a new family of graphs, for which computing the chromatic number can be done in polynomial time.

2002-561 P. Smolíková, ed.
Eight Midsummer Combinatorial Workshop

2002-562 J. Kára and D. Král'
Optimal Free Binary Decision Diagrams for Computation of EAR_n

Free binary decision diagrams (FBDDs) are graph–based data structures representing Boolean functions with a constraint (additional to binary decision diagrams) that each variable is tested during the computation at most once. The function EAR_n is a Boolean function on $n \times n$ Boolean matrices; $\mathrm{EAR}_n(M) = 1$ iff the matrix M contains two equal adjacent rows. We prove that the size of optimal FBDDs computing EAR_n is $2^{\Theta(\log^2 n)}$.

2002-563 D. Král', V. Majerech, J. Sgall, T. Tichý, and G. Woeginger
It is tough to be a plumber

In the Linux computer game `KPlumber`, the objective is to rotate tiles in a raster of squares so as to complete a system of pipes. We give a complexity classification for the original game and various special cases of it that arise from restricting the set of six possible tiles.

Most of the cases are NP-complete. One polynomially solvable case is settled by formulating it as a perfect matching problem; other polynomial cases are settled by simple sweepline techniques. Moreover, we show that all the unsettled cases are polynomial time equivalent.

2002-564 J. Matoušek, ed.
Workshop on Discrete Metric Spaces and their Algorithmic Applications

Finite metric spaces have emerged in recent years as a new and influential branch of discrete mathematics, with deep and surprising applications in Computer Science. The Workshop on Discrete Metric spaces and their Algorithmic Applications was organized at the Holiday Inn Hotel in Haifa, Israel, in March 2002, with the aim of summarizing the achievements in this area to date and clarifying the core questions of the emerging field.

The participation was very strong and included experts from quite diverse fields, ranging from Banach spaces to approximation algorithms. The scientific programme consisted of 23 talks, from one-hour tutorials to short presentations, and a problem session.

The open problems collected in this booklet have been presented during the talks at the workshop (in particular, an opening lecture by Nathan Linial was mostly devoted to open problems), during the problem session, or contributed later by the participants. The heading of each problem includes a short title (mostly assigned by the editor, in order to facilitate a quick orientation) and the name of the person presenting the problem. This is not necessarily the original author of the question; some of the problems seem to be folklore and it may be nontrivial to trace their origins. The problems were open, to the best knowledge of the people presenting them, at the time of editing this collection.

2002-565 J. J. Montellano-Ballesteros, R. Strausz

A characterization of cocircuit graphs of uniform oriented matroids

In this paper the *Radon complex* of an oriented matroid is introduced. It is a natural poset associated to the Radon partitions of a *separoid* —a natural generalization of an oriented matroid— which, in their turn, will be defined. We show that, in the *uniform* case, the 1-skeleton of the Radon complex' dual is the oriented matroid's *cocircuit graph*. This leads to a characterization of such graphs via a natural metric defined in the k-*dual* of the n-cube.

2002-566 J. Bracho, R. Strausz

Separoids and characterization of linear uniform oriented matroids

In this paper the *geometric dimension* of an oriented matroid is introduced. It is the minimal euclidian dimension where its *separoid* (to be defined) can be realized as a family of convex sets. We show that in the *uniform* case, it is enough to know this invariant to decide if the oriented matroid is *linear*.

2002-567 M. DeVos, J. Nešetřil, and A. Raspaud

On flow and tension-continuous maps

A *cycle* of a graph G is a set $C \subseteq E(G)$ so that every vertex of the graph $(V(G), C)$ has even degree. If G, H are graphs, we define a map $\phi : E(G) \to E(H)$ to be *cycle-continuous* if the pre-image of every cycle of H is a cycle of G. A fascinating conjecture of Jaeger asserts that every bridgeless graph has a cycle-continuous mapping to the Petersen graph. Jaeger showed that if this conjecture is true, then so is the 5-cycle-double-cover conjecture and the Fulkerson conjecture.

Cycle continuous maps give rise to a natural quasi-order $\succ$ on the class of finite graphs. Namely, $G \succ H$ if there exists a cycle-continuous mapping from G to H. The goal of this paper is to study this and other related quasi-orders. In particular, we establish a number of connections between structural properties of these quasi-orders and traditional flow/coloring problems. Particulary we etablish the existence of arbitrarily large finite antichains with respect to the cycle continuous order. (Even the existence of antichains of size 2 was a problem). Our framework also leads to a variety of new questions. For instance, the following problem concerns a basic property of $\succ$ which we have been unable to resolve. Is there an infinite set of incomparable graphs under the order $\succ$?

2002-568 H. Broersma, F.V. Fomin, J. Nešetřil, and G.J. Woeginger
More about subcolorings

A subcoloring is a vertex coloring of a graph in which every color class induces a disjoint union of cliques. We derive a number of results on the combinatorics, the algorithmics, and the complexity of subcolorings.

On the negative side, we prove that 2-subcoloring is NP-hard for comparability graphs, and that 3-subcoloring is NP-hard for AT-free graphs and for complements of planar graphs. On the positive side, we derive polynomial time algorithms for 2-subcoloring of complements of planar graphs, and for r-subcoloring of interval and of permutation graphs. Moreover, we prove asymptotically best possible upper bounds on the subchromatic number of interval graphs, chordal graphs, and permutation graphs in terms of the number of vertices.

2002-569 D. Král'
An Exact Algorithm for the Channel Assignment Problem

A channel assignment problem is determined by a triple (V, E, w) where V is a vertex set, E an edge set and w is a function assigning edges positive integer weights. An assignment c of integers between 1 and K to the vertices is proper if $|c(u) - c(v)| \geq w(uv)$ for each $uv \in E$; the smallest K for which there is a proper assignment is the span of the problem. The problem is l-bounded if the values of w do not exceed l.

An algorithm running in time $O(n(l+2)^n)$ for computing the span of an l-bounded channel assignment problem with n vertices is presented and we discuss (im)possibility of designing a faster algorithm based on maximal independent set approach. We further find an algorithm running in time

$O(nl(l+2)^n)$ for computing the number of different proper assignments of span at most K.

2002-570 A. Bagchi, A. Chaudhary, C. Scheideler, and P. Kolman
Algorithms for Fault-Tolerant Routing in Circuit Switched Networks

In this paper we consider the k *edge-disjoint paths problem* (k-EDP), a generalization of the well-known edge-disjoint paths problem. Given a graph $G = (V, E)$ and a set of terminal pairs (or requests) T, the problem is to find a maximum subset of the pairs in T for which it is possible to select paths such that each pair is connected by k edge-disjoint paths and the paths for different pairs are mutually disjoint. To the best of our knowledge, no nontrivial result is known for this problem for $k > 1$. To measure the performance of our algorithms we will use the recently introduced flow number F of a graph. This parameter is known to fulfill $F = O(\Delta\alpha^{-1} \log n)$, where Δ is the maximum degree and α is the edge expansion of G. We show that a simple, greedy online algorithm achieves a competitive ratio of $O(k^3 \cdot F)$, which naturally extends the best known bound of $O(F)$ for $k = 1$ to higher k. To achieve this competitive ratio, we introduce a new method of converting a system of k disjoint paths into a system of k length-bounded disjoint paths. We also show that any deterministic online algorithm has a competitive ratio of $\Omega(k \cdot F)$.

In addition, we study the k *disjoint flows problem* (k-DFP), which is a generalization of the well-known unsplittable flow problem (UFP). The k-DFP is similar to the k-EDP with the difference that we now consider a graph with edge capacities and the requests can have arbitrary demands d_i. The aim is to find a subset of requests of maximum total demand for which it is possible to select flow paths such that all the capacity constraints are maintained and each selected request with demand d_i is connected by k disjoint paths, each of flow value d_i/k.

The k-EDP and k-DFP problems have important applications in fault-tolerant (virtual) circuit switching, which plays a key role in optical networks.

2002-571 B. Banaschewski, A. Pultr
A constructive view of complete regularity

This note introduces the largest interpolative relation contained in the rather below(= well inside) relation in a frame as a constructive version of the familiar completely below (= really inside) relation.It establishes several constructively valid results for this whose analogues for the latter are only proved by means of the Axiom of Countable Dependent Choice.

2002-572 D. Král', T. Madaras, and R. Škrekovski
Cyclic, Diagonal and Facial Colorings

In an l-facial coloring, any two different vertices joined by a facial walk of length at most l receive distinct colors. The concept of facial coloring extends the well-known concept of cyclic coloring. We prove that $\lfloor \frac{18l}{5} \rfloor + 2$ colors suffice for an l-facial coloring of a plane graph. For $l = 2$, 3 and 4, the upper bounds of 8, 12 and 15 colors are shown. We use our results on facial coloring to decrease to 16 the upper bound on the number of colors needed for 1-diagonal coloring of plane quadrangulations.

2002-573 J. Fiala, J. Kratochvíl, and A. Proskurowski
Systems of sets and their representatives

We introduce a new notion of Systems of Distant Representatives of families of subsets of a metric space. We are in particular interested in the computational complexity of deciding the existence of such systems, for different distance parameters and for various metric spaces. The problem contains as a subproblem the well known polynomial time solvable problem of Systems of Distinct Representatives (for discrete metric and distance parameter 1). We prove several NP-hardness results, e.g., for discrete metric and distance parameter 2, or for Euclidean metric spaces. We also show a direct connection to practically motivated and previously studied problems such as scheduling, distance constrained graph labeling, map labeling, disjoint representatives of hypergraphs and independent sets in graphs.

2002-574 E. Bampis, M. Caramia, J. Fiala, A.V. Fishkin,
and A. Iovanella
On-line scheduling of independent dedicated multiprocessor tasks

We study the off and on-line versions of the well known problem of scheduling a set of n independent multiprocessor tasks with prespecified processor allocations on a set of identical processors in order to minimize the makespan. Recently, by Fishkin, Jansen, and Porkolab, it has been proven that in the case when all tasks have unit processing time the problem cannot be approximated within a factor of $m^{\frac{1}{2}-\varepsilon}$, neither for some $\varepsilon > 0$, unless P= NP; nor for any $\varepsilon > 0$, unless NP=ZPP. For this special case we give a simple algorithm based on the classical first-fit technique. We analyze the algorithm for both tasks *arrive over time* and tasks *arrive over list* on-line scheduling versions, and show that its competitive ratio is bounded by $2\sqrt{m}$ and $2\sqrt{m}+1$, respectively. Here we also use some preliminary results on (vertex) coloring of k-tuple graphs. For the case of arbitrary processing times, we show that any algorithm which uses the first-fit technique cannot be better than m competitive. Then, by using our split-round technique, we give a $3\sqrt{m}$-approximation algorithm for the off-line version of the problem. Finally, by using some ideas by Shmoys, Wein, and Williamson we adapt the algorithm to the on-line case, in the paradigm of *tasks arriving over time* in which the existence of a task is unknown until its release date, and show that its competitive ratio is bounded by $6\sqrt{m}$. Due to the conducted experimental results, we conclude that our algorithms can perform well in practice.

2002-575 A. Pultr and W. Tholen
Free Quillen Factorization Systems

The notion of Quillen factorization system is obtained by strengthening the left and right lifting properties in a Quillen model category to the unique diagonalization property. An equivalent description of this notion is given in terms of a double factorization system which decomposes each arrow uniquely into three factors. The free category with Quillen factorization system over a given category is described.

2002-576 M. Klazar
Extremal problems for ordered (hyper)graphs: applications of Davenport–Schinzel sequences

We introduce a containment relation of hypergraphs which respects linear orderings of vertices and investigate associated extremal functions. We extend, by means of a more generally applicable theorem, the $n \log n$ upper bound on the ordered graph extremal function of $F = (\{1,3\},\{1,5\},\{2,3\},\{2,4\})$ due to Füredi to the $n(\log n)^2(\log\log n)^3$ upper bound in the hypergraph case. We use Davenport–Schinzel sequences to derive almost linear upper bounds in terms of the inverse Ackermann function $\alpha(n)$. We obtain such upper bounds for the extremal functions of forests consisting of stars whose all centers precede all leaves.

2002-577 V. Franěk

Low-discrepancy Lattice Sets and QMC Integration

Many low-discrepancy sets are suitable for quasi-Monte Carlo integration. Skriganov showed that the intersections of suitable lattices with unit cube have low discrepancy. We introduce adaptive algorithm based on linear programming which scales any given lattice approprietly and computes its intersection with unit cube. We compare the quality of numerical integration using these low-discrepancy lattice sets with approximations using other known (quasi-)Monte Carlo methods. The comparison is based on several numerical experiments, where we consider both the precision of the approximation and the speed of generating of the sets. We conclude that up to dimensions about 15, low-discrepancy lattices yield fairly good results. In higher dimensions, the computation of the intersection takes too long and ceases to be feasible.

2002-578 J. Fiala, A.V. Fishkin, F.V. Fomin

On-line and off-line distance constrained labeling of disk graphs

A disk graph is the intersection graph of a set of disks in the plane. We consider the problem of assigning labels to vertices of a disk graph satisfying a sequence of distance constrains. Our objective is to minimize the distance between the least and the largest labels. We propose an on-line labeling algorithm on disk graphs, if the maximum and minimum diameters are bounded. We give the upper and lower bounds on its competitive ratio, and show that the algorithm is asymptotically optimal. In more detail we explore the case of distance constraints $(2, 1)$, and present two off-line approximation algorithms. The last one we call robust, i.e. it does not require the disks representation and either outputs a feasible labeling, or answers the input is not a unit disk graph.

2002-579 D. Král', R. Škrekovski

Borodin's Conjecture on Diagonal Coloring is False

In a 1-diagonal coloring, vertices of any face and vertices of any two faces sharing an edge have to get different colors. Borodin proved that any triangulation of a surface of Euler genus $g \geq 2$ can be 1-diagonally colored by $\lfloor \frac{13+\sqrt{73+48g}}{2} \rfloor$ colors. The bound is conjectured to be sharp for all surfaces except for the plane. We disprove this conjecture.

2002-580 A. Pultr, A. Tozzi

A monad for domains and other categories

A small modification of Vickers' definition of continuous information systems allows for a representation of the category of continuous domains (continuous DCPOs) and several other categories (Scott domains, continuous Scott domains, continuous lattices, algebraic lattices, and others) as Kleisli categories of suitable monads.

2002-581 A. Pultr, A. Tozzi

Continuous DCPOs as complete information systems

Continuous DCPOs are shown to be precisely the complete objects (in the sense of the completions of Brümmer, Giuli and Herrlich) in a certain category of generalized information systems (related to those of Vickers), with naturally defined morphisms and embeddings.

2002-582 M. Nehéz

The Compactness Lower Bound of Shortest-path Interval Routing on $n \times n$ Tori with Random Faulty Links

In this paper we consider that a communication network is given by a 2-dimensional square torus with independently faulty links that is modelled by a random graph. We prove the lower bound on compactness of shortest-path interval routing for a random 2-dimensional torus of the order N in the form $\Omega(\sqrt{\log N})$ with probability of at least $1 - o(1)$. This is the first non-constant compactness lower bound for random tori. The trivial upper bound is $O(N)$.

2002-583 J. Alber, J. Fiala

Geometric Separation and Exact Solutions for the Parameterized Independent Set Problem on Disk Graphs

We consider the parameterized problem, whether for a given set $\mathcal{D}$ of n disks (of bounded radius ratio) in the Euclidean plane there exists a set of k non-intersecting disks. We expose an algorithm running in time $n^{O(\sqrt{k})}$, that is—to our knowledge—the first algorithm for this problem with running time bounded by an exponential with a sublinear exponent. For λ-precision disk graphs of bounded radius ratio, we show that the problem is fixed parameter tractable with respect to parameter k.

The results are based on a new "geometric $\sqrt{\cdot}$-separator theorem" which holds for all disk graphs of bounded radius ratio. The presented algorithm then performs, in a first step, a "geometric problem kernelization" and, in a second step, uses divide-and-conquer based on our geometric separator theorem.

Our techniques can be extended to various other graph problems, such as DOMINATING SET, to obtain similar results for disk graphs of bounded radius ratio.

2002-584 R. Šámal
Flows and Colorings of Graphs

We present an overview of the theory of nowhere zero flows, in particular the duality of flows and colorings, and the extension to antiflows and strong oriented colorings. As the main result, we find the asymptotic relation between oriented and strong oriented chromatic number.

2002-585 J. Nešetřil, P. Ossona de Mendez
Folding

We define folding of a directed graph as a coloring (or a homomorphism) which is injective on all the *down sets* of a given depth. While in general foldings are as complicated as homomorphisms for some some classes they present an useful tool to study colorings and homomorphisms. Our main result yields for any proper minor closed class $\mathcal{K}$ a folding (of any prescribed depth) using a fixed number of colors. This in turn yields (for any $\mathcal{K}$) the existence of a K_k-free graph which bounds all K_k-free graphs belonging to $\mathcal{K}$. This has been conjectured by the first author and solved for $k = 3$. Particularly, we prove (without using 4CT) the existence of a graph H which satisfies $\chi(H) \leq 5$, $\omega(H) \leq 4$ and such that any planar graph G is homomorphic to H. This is sandwiched between 4CT and 5CT for planar graphs and the general case has bearing to Hadwiger Conjecture.

2002-586 Z. Dvořák, D. Král', and R. Škrekovski
Coloring Face Hypergraphs on Surfaces

The face hypergraph of a graph G embedded in a surface has the same vertex set as G and its edges are the sets of vertices forming faces of G.

A Hypergraph is k-choosable if for each assignment of lists of colors of sizes k to its vertices, there is a coloring of the vertices from these lists avoiding a monochromatic edge.

We prove that the face hypergraph of a triangulation of a surface of Euler genus g is $O(\sqrt[3]{g})$-choosable. This bound matches a previously known lower bound of the order $\Omega(\sqrt[3]{g})$. If each face of the graph is incident with at least r vertices, then the face hypergraph is $O(\sqrt[r]{g})$-choosable. Separate results for small genera are presented: The bound of 3 for triangulations of surfaces of Euler genus $g = 3$ and the bound of $\left\lceil \frac{7+\sqrt{36g+49}}{6} \right\rceil$ for $g \geq 3$ are shown. Our results dominate the previously known bounds for all genera except for $g = 4, 7, 8, 9, 14$.

2002-587 Z. Dvořák, J. Kára, D, Král', and O. Pangrác

Feasible Sets of Pattern Hypergraphs

A pattern $(\Pi_1, \ldots, \Pi_\lambda)$-hypergraph H is a hypergraph $(V, \mathcal{E})$ with edge types Π_i; each of Π_i is a set of equivalences. Each edge of H is assigned one of the edge types Π_i. A coloring c of H is proper if for each Π_i-edge E the color classes of c on E form an equivalence which is contained in the type Π_i. The feasible set of H is the set of all k's for which there is a proper coloring using exactly k colors.

We prove a simple sufficient and necessary condition on $(\Pi_1, \ldots, \Pi_\lambda)$ for the existence of a pattern $(\Pi_1, \ldots, \Pi_\lambda)$-hypergraph H whose feasible set is not an interval of integers.

2002-588 M. Klazar

Kaleidoskop teorie čísel (7. kapitola)

Toto je předběžný text 7. kapitoly o číselných rozkladech ze skript k mé přednášce *Úvod do teorie čísel*, kterou jsem konal na MFF UK v Praze v zimních semestrech školních roků 1996/97, 1998/99, 1999/00, 2000/01 a 2001/02. Zatím v preprintové řadě KAM-DIMATIA Series vyšly kapitoly 1 (základní pojmy a obraty), 2 (diofantické aproximace), 3 (diofantické rovnice), 4 (kongruence) a 5 (prvočísla) a budou v ní postupně vydány zbylé kapitoly 6 (geometrie čísel), 8 (medailony matematiků) a 9 (návody k řešením úloh).

2002-589 T. Madaras, R. Škrekovski, and H.-J. Voss
The 7-cycle C_7 is light in the family of planar graphs with minimum degree 5

A connected graph H is said to be light in the class of graphs $\mathcal{H}$ if there exists a positive integer k such that each graph $G \in \mathcal{H}$ that contains an isomorphic copy of H contains a subgraph K isomorphic to H that satisfies the inequality $\sum_{v \in V(K)} \deg_G(v) \leq k$. It is known that an r-cycle C_r is light in the family of planar graphs with minimum degree 5 if $3 \leq r \leq 6$, and not light for $r \geq 11$. We prove that C_7 is also light in this family

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2002-590 V. Jungić, J. Licht, M. Mahdian, J. Nešetřil, and R. Radoičić
Rainbow Arithmetic Progressions and Anti-Ramsey Results

The van der Waerden theorem in Ramsey theory states that for every k and t and sufficiently large N, every k-coloring of $[N]$ contains a monochromatic arithmetic progression of length t. Motivated by this result, Radoičić conjectured that every equinumerous 3-coloring of $[3n]$ contains a 3-term rainbow arithmetic progression, i.e., an arithmetic progression whose terms are colored with distinct colors. In this paper, we prove that every 3-coloring of the set of natural numbers for which each color class has density more than $1/6$, contains a 3-term rainbow arithmetic progression. We also prove similar results for colorings of $\mathbb{Z}_n$. Finally, we give a general perspective on other *anti-Ramsey-type* problems that can be considered.

2002-591 B. Banaschewski and A. Pultr
A General View of Approximation

2002-592 J. Nešetřil and P. Ossona de Mendez
Cuts and Bounds

We consider the colouring (or homomorphism) order $\mathcal{C}$ induced by all finite graphs and the existence of a homomorphism between them. This ordering may be seen as a lattice which is however far from being complete. In this paper we study bounds and suprema and maximal elements in $\mathcal{C}$ of some frequently studied classes of graphs (such as bounded degree, degenerated and classes determined by a finite set of forbidden subgraphs). We relate these extrema to cuts of subclasses $\mathcal{K}$ of $\mathcal{C}$ (cuts are finite sets which are comparable to every element of the class $\mathcal{K}$). We determine all cuts for classes of degenerated graphs. For classes of bounded degree graphs this seems to be a very difficult problem which is also mirrored by the fact that these classes fail to have a supremum. We note a striking difference between undirected and oriented graphs. This is based on the recent work of C. Tardif and J. Nešetřil. Also minor closed classes are considered and we survey recent results obtained by authors. A bit surprisingly this order setting captures Hadwiger conjecture and suggests some new problems.

2002-593 T. Feder, P. Hell, S. Klein, and R. Motwani
List Partitions

List partitions generalize list colourings and list homomorphisms. Each symmetric matrix M over $0, 1, *$ defines a list partition problem. Different choices of the matrix M lead to many well-known graph theoretic problems including the problem of recognizing split graphs and their generalizations, finding homogeneous sets, joins, clique cutsets, stable cutsets, skew cutsets and so on. We develop tools which allow us to classify the complexity of many list partition problems and, in particular, yield the complete classification for small matrices M. Along the way, we obtain a variety of specific results including: generalizations of Lovász's communication bound on the number of clique-versus-stable-set separators; polynomial-time algorithms to recognize generalized split graphs; a polynomial algorithm for the list version of the Clique Cutset Problem; and the first subexponential algorithm for the Skew Cutset Problem of Chvátal. We also show that the dichotomy (NP-complete versus polynomial-time solvable), conjectured for certain graph homomorphism problems would, if true, imply a slightly weaker dichotomy (NP-complete versus quasipolynomial) for our list partition problems.

2002-594 P. Kolman
A Note on the Greedy Algorithm for the Unsplittable Flow Problem

In a recent paper Chekuri and Khanna improved the analysis of the Greedy algorithm for the Edge Disjoint Paths problem and proved the same bounds also for the related Uniform Capacity Unsplittable Flow Problem. Here we show that their ideas can be used to get the same approximation ratio even for the more general Unsplittable Flow Problem with nonuniform edge capacities.

2002-595 J. Fiala and D. Paulusma

The computational complexity of the role assignment problem

A graph G is R-role assignable if there is a locally surjective homomorphism from G to R, i.e. a vertex mapping $r : V_G \to V_R$, such that the neighborhood relation is preserved: $r(N_G(u)) = N_R(r(u))$. Kristiansen and Telle conjectured that the decision problem whether such a mapping exists is an NP-complete problem for any connected graph R on at least three vertices. In this paper we prove the conjecture and show further corollaries for disconnected graphs and related problems.

2002-596 M. Loebl

On Ground State Incongruence in Spin Glasses

A construction supporting a conjecture that different ground state pairs exist in the 2-dimensional Edwards-Anderson Ising spin glass is presented.

2002-597 D. Piguetová

A canonical Ramsey-type theorem for finite subsets of N

T. Brown proved that whenever we color $\mathcal{P}_f(\mathbb{N})$ (the set of finite subsets of natural numbers) with finitely many colors, we find a monochromatic structure, called an arithmetic copy of an ω-forest.

In this paper we show a canonical extension of this theorem; i.e. whenever we color $\mathcal{P}_f(\mathbb{N})$ with arbitrarily many colors, we find a canonically colored arithmetic copy of an ω-forest. The five types of the canonical coloring are determined. This solves a problem of T. Brown.

2002-598 A. Pór and P. Valtr

On the partitioned version of the Erdös–Szekeres theorem

Let $k \geq 4$. A finite planar point set X is called a convex k-clustering, if it is a disjoint union of k sets $X_1, \ldots, X_k$ of equal sizes such that $x_1 x_2 \ldots x_k$ is a convex k-gon for each choice of $x_1 \in X_1, \ldots, x_k \in X_k$. Answering a question of Gil Kalai, we show that for every $k \geq 4$ there are two constants $c = c(k)$, $c' = c'(k)$ such that the following holds. If X is a finite set of points in general position in the plane then it has a subset X' of size at most c' such that $X \setminus X'$ can be partitioned into at most c convex k-clusterings. The special case $k = 4$ was proved earlier by Pór. Our result strengthens the so-called positive fraction Erdős–Szekeres theorem proved by Bárány and Valtr. The proof gives reasonable estimates on c and c', and it works also in higher dimensions. We also improve the previous constants for the positive fraction Erdős–Szekeres theorem obtained by Pach and Solymosi.

2002-599 P. Valtr

A sufficient condition for the existence of large empty convex polygons

Let P be a set of points in general position in the plane. We say that P is k-convex, if no triangle determined by P contains more than k points of P in the interior. We say that a subset A of P in convex position forms an *empty polygon* (in P), if no point of $P \setminus A$ lies in the convex hull of A. We show that for any k, n there is an $N = N(k, n)$ such that any k-convex set of at least N points in general position in the plane contains an empty n-gon. We also prove an analogous statement in $\mathbb{R}^d$ for each odd $d \geq 3$.
