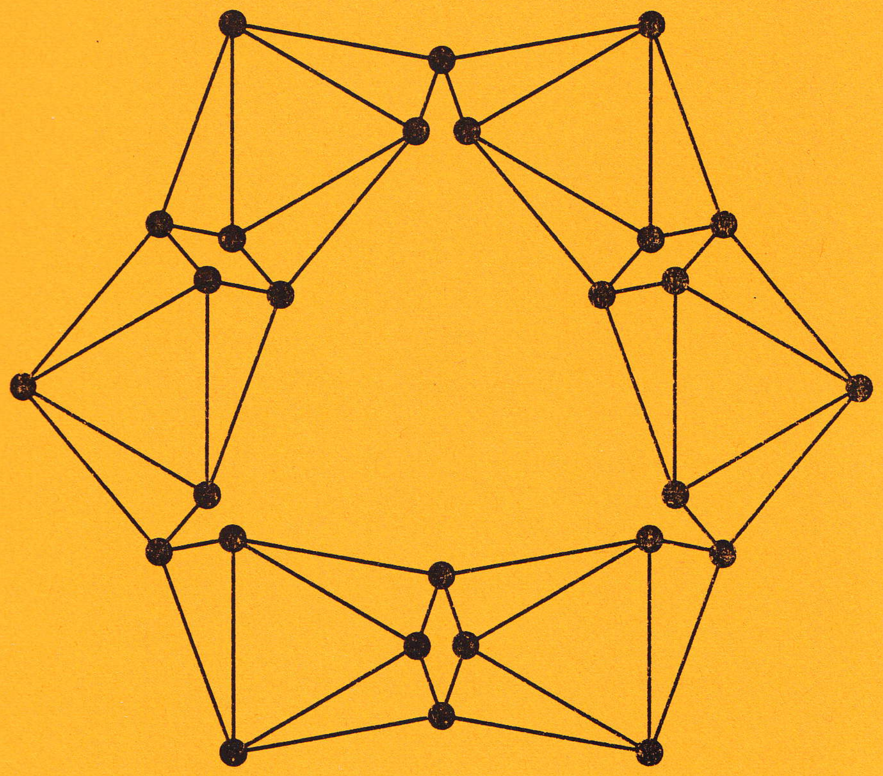
KOLLOQUIUM
ÜBER
KOMBINATORIK

13.-14. November 1998



Diskrete Mathematik

TECHNISCHE UNIVERSITÄT BRAUNSCHWEIG

KOLLOQUIUM ÜBER KOMBINATORIK – 13. UND 14. NOVEMBER 1998
DISKRETE MATHEMATIK – TU BRAUNSCHWEIG

Liebe Teilnehmerinnen und Teilnehmer:

Zum 18. "Kolloquium über Kombinatorik", das zum siebten Mal hier in Braunschweig stattfindet, möchten wir Sie alle recht herzlich hier in der Technischen Universität Carolo-Wilhelmina begrüßen. Wir freuen uns über alle regelmäßigen Teilnehmer ebenso wie über diejenigen, die zum ersten Male gekommen sind.

Für vielfältige Hilfen bedanken wir uns auch an dieser Stelle bei vielen Freiwilligen vornehmlich aus der Studentenschaft.

Vielen Dank möchten wir auch dem Präsidenten unserer TU Braunschweig, Herrn Prof. Dr. Bernd Rebe, für eine finanzielle Unterstützung sagen.

Wir wünschen allen einen guten Erfolg bei der Tagung und einen angenehmen Aufenthalt in Braunschweig.

Heiko Harborth
Arnfried Kemnitz
Christian Thürmann
Hartmut Weiß

Diskrete Mathematik
Technische Universität Braunschweig

Freitag, 13. 11. 1998

9:30 **Eröffnung** (Hörsaal: PK 4.3)

9:45 **V. Chepoi (Marseille, France)** (Hörsaal: PK 4.3)
"Superconnected subsets of hypercubes"

10:40 **Kaffeepause**

10:55 **R. Diestel (Chemnitz, Germany)** (Hörsaal: PK 4.3)
"Why is the tree-width of that graph large?"

11:50–13:30 **Mittagspause**

11:55–12:10 Special Meeting of the Institute of Combinatorics and its Applications (Hörsaal: PK 4.3)

Zeit	Sektion I Raum PK 14.3	Sektion II Raum PK 14.4	Sektion III Raum PK 14.6	Sektion IV Raum PK 14.7	Sektion V Raum PK 14.8
13.30	**P. Tittmann** 1 Reliability polynomial	**E. Steffen** 2 About two conjectures of Vizing	**M. Kriesell** 3 All 4-connected line graphs of claw free graphs are hamiltonian connected	**J.-P. Bode** 4 Knight independence on triangular hexagon boards	**D. Kratsch** 5 Chordality and 2-factors in tough graphs
14.00	**K. Dohmen** 6 Ein Polynomzeit-Schema für das Prinzip der Inklusion-Exklusion	**S. Gerke** 7 Colouring weighted bipartite graphs with a co-site constraint	**I. Schiermeyer** 8 Cycles in Japan: Vertex-pancyclic graphs and cycle partitions	**I. Fabrici** 9 Connected subgraphs with small degrees in polyhedral graphs	**S. Guttmann** 10 Recognition of bandwidth-k k-connected graphs
14.30	**M. Grüttmüller** 11 Nonexistence criteria for PBD's with block sizes 4 and k	**A. Hackmann** 12 Kantenfärbungen planarer Graphen	**L. Babel** 13 Recognizing the P_4-structure of claw-free graphs	**M. Atici** 14 Unary and binary operations of graphs and their geodetic number	**T. Szymczak** 15 The complexity of some problems related to graph 3-colorability
15.00	**A. L. Larsen** 16 Chip firing and Cayley's formula	**S. Brandt** 17 Colouring dense triangle-free graphs	**E. Köhler** 18 Hamiltonian cycles in subclasses of AT-free graphs	**A. Pönitz** 19 Automatische Erzeugung von Algorithmen zur Berechnung von Invarianten in Graphen beschränkter Breite	**S. Böcker** 20 Patching up X-trees
15.30	**F. Luca** 21 How palindromic are the rows of the Pascal triangle?	**B. Randerath** 22 Colouring graphs with prescribed induced cycle lengths	**U. Leck** 23 Self-orthogonal Hamilton path decompositions of complete graphs	**D. Fronček** 24 2-halvable complete 4-partite graphs	**C. Hendler** 25 About the cliquecoveringnumber of boxgraphs
16.00	**Kaffeepause**				
16.30	**T. Harmuth** 26 Enumeration of cubic toroidal maps	**S. Grünewald** 27 Chromatic-index critical graphs of even order	**J. Harant** 28 On lower bounds on independence	**S.L. Bezrukov** 29 A local-global principle for vertex-isoperimetric problems	**M. Sonntag** 30 Antimagic vertex-labeling of hypergraphs
17.00	**H. Mielke** 31 Meanders	**V. Korzhyk** 32 On the 1-chromatic number of nonorientable surfaces	**T. Tautenhahn P. Willenius** 33 Dominance properties for sets of sequences	**M. Tewes** 34 Cycles and indegrees of in-tournaments	**H.-M. Teichert** 35 The sum number of d-partite complete hypergraphs
17.30	**G. Agnarsson** 36 Asymptotic estimation on certain Product Ramsey Numbers	**M. Voigt** 37 Partial list colorings	**M. Naatz** 38 The graph of linear extensions of a poset	**L.K. Jørgensen** 39 Search for directed strongly regular graphs	**E. Prisner** 40 Intersection graphs of linear 3-uniform hypergraphs
18.00	**A. Schelten** 41 On multicolored Ramsey-numbers	**U. Baumann** 42 Permutation groups and coloured graphs	**A. Taraz** 43 The evolution of partially ordered sets	**M. Kochol** 44 Hypothetical complexity of the nowhere-zero 5-flow problem	**H.-H. Scheel** 45 Some geometric problems concerning algebraic linear programming

19.00 **Gemeinsames Abendessen** im Ristorante „da Paolo", Lindenhof

Sonnabend, 14. 11. 1998

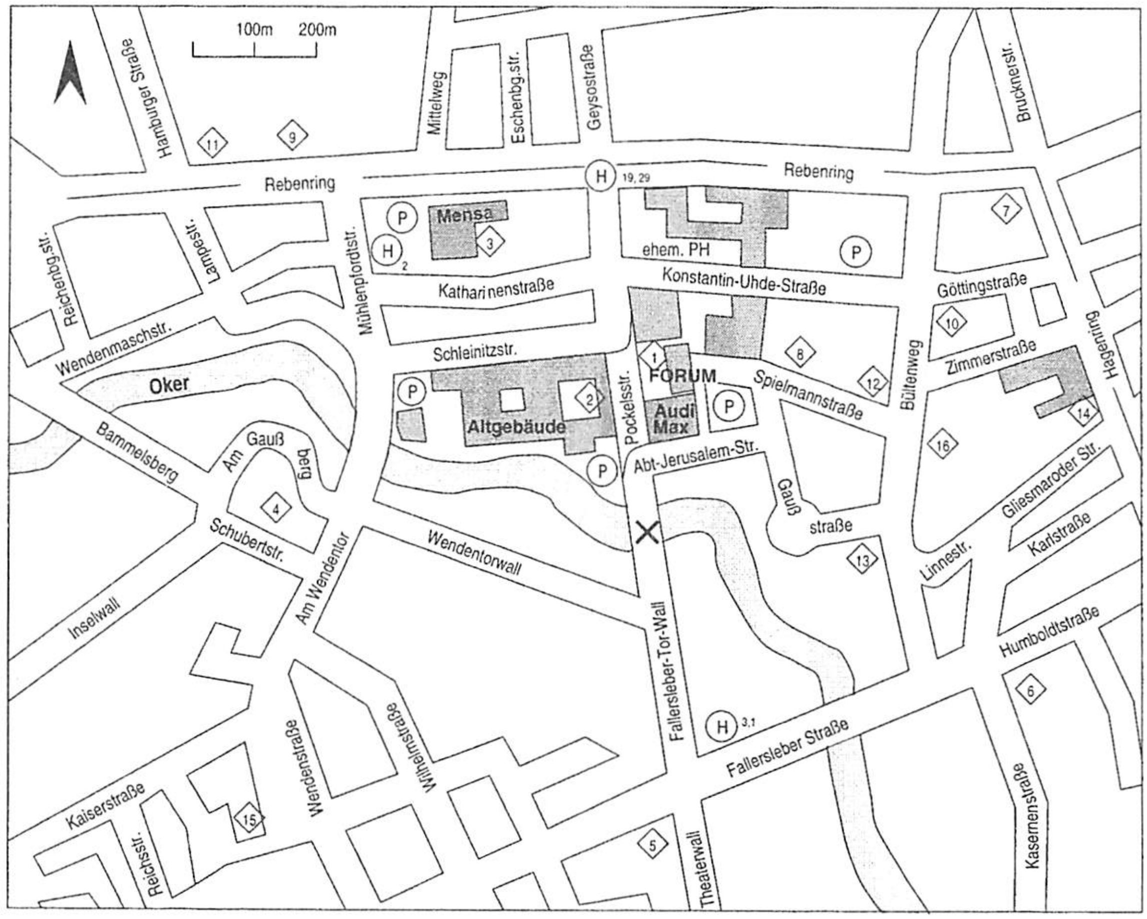
9:45	**T. Bisztriczky (Calgary, Canada)** "A survey of cyclic polytopes"	(Hörsaal: PK 4.3)
10:40	**Kaffeepause**	
10:55	**J. Pach (Budapest, Hungary)** "Crossing numbers of graphs"	(Hörsaal: PK 4.3)
11:50–13:00	**Mittagspause**	

Zeit	Sektion I Raum PK 14.3	Sektion II Raum PK 14.4	Sektion III Raum PK 14.6	Sektion IV Raum PK 14.7	Sektion V Raum PK 14.8
13.00	**S. Jendroľ** 46 Recent results on cyclic chromatic number of 3-connected planar graphs	**M. Deza** 47 4-dimensional fullerenes	**D. Cieslik** 48 The Steiner ratio of metric spaces	**T. Schoen** 49 On the density of sets containing no three distinct elements with all their sums	**R. Elsässer** 50 The spider poset is Macaulay
13.30	**T. Böhme** 51 Labeled $K_{2,t}$-minors in plane graphs	**G. Wesp** 52 Chirotopes and Pfaffians	**W. Imrich** 53 Products of graphs	**U. Tönges** 54 Coherence of metrics on six points	**E. Gerbracht** 55 Erweiterungen von C^*-Algebren via Erzeugender und Relationen
14.00	**S. Felsner** 56 Posets and planar graphs	**G. Brinkmann** 57 Mathematics, chemistry and record hunting	**R. Labahn** 58 Construction methods for sparse gossip graphs	**A. E. Schroth** 59 How to draw a hexagon	**A. Baltz** 60 Large h-Sidon sets in abelian groups
14.30	**D. Rautenbach** 61 Embedding two edge-disjoint copies of a tree in a complete bipartite graph of the same order	**E. Harzheim** 62 Ein diskretes Analogon zum Begriff "rechtsseitiger Häufungspunkt"	**A. Recski** 63 Some new matroidal constructions on the edge set of graphs	**T. Pisanski** 64 Weakly flag-transitive configurations	**T. Lange** 65 Factorization of polynomials over arbitrary finite fields
15.00	**Kaffeepause**				
15.30	**H. Gropp** 66 On the life and combinatorial work of Levi and Steinitz	**M.J. Jiménez Rodrígues** 67 Discrete methods in algebraic topology	**U.v. Nathusius** 68 Generating 3-regular maps with given face sizes	**A. Winterhof** 69 On the non-existence of generalized Hadamard matrices	**D. Osthus** 70 Sperner properties of random subsets of a finite set
16.00	**U. Eckhardt** 71 Root images of median filters	**H. Hassenpflug** 72 Lineare homogene partielle Differenzengleichungen	**H.K. Aydinian** 73 On perfect codes and related concepts	**B. Doerr** 74 Linear and hereditary discrepancy	**J. Quistorff** 75 Über volle partielle Quasigruppen endlicher Ordnung

Raumplan

Hauptvorträge	:	Hörsaal PK 4.3 (Altgebäude, Pockelsstraße 4)
Sektionsvorträge	:	Hörsäle PK 14.3 und PK 14.4 (Forum, 3. Stockwerk) Hörsäle PK 14.6, PK 14.7 und PK 14.8 (Forum, 5. Stockwerk)
Tagungsbüro	:	F 314 (Forum, Pockelsstraße 14, 3. Stockwerk)
Bibliothek	:	F 416 (Forum, 4. Stockwerk)
Cafeteria	:	F 314/315 (Forum, 3. Stockwerk)
Arbeitsraum	:	F 507 (Forum, 5. Stockwerk)
Fernsprecher	:	Erdgeschoß des Forumsgebäudes; Altgebäude, in der Nähe des Hörsaales PK 4.3; Pockelsstraße, gegenüber der Universitätsbibliothek (Münz- und Kartenfernsprecher)

Öffnungszeiten von Tagungsbüro, Bibliothek, Cafeteria und Arbeitsraum: Freitag, 9^{00}–18^{30}h; Sonnabend, 9^{00}–16^{30}h.



1 Forum, Pockelsstraße 14
2 Altgebäude, Pockelsstraße 4
3 Mensa, Katherinenstraße 1
4 Gaußdenkmal
5 Mephisto, Fallerslebersraße 35, 15:00–3:00
6 Ristorante "da Paolo" (Lindenhof), Kasernenstraße 20, 11:30–15:00, 18:00–23:00

7 Dialog (Bistro), Rebenring 48, 11:30–24:00
8 Eusebia (Bistro), Spielmannstraße 11, 9:00–2:00
9 Griechische Taverne, Rebenring 8a, 12:00–14:30, 17:30–0:00
10 Konfuzius (Chinesisch), Bültenweg 81, 11:30–15:00, 18:00–23:30
11 Ana (Türkisch), Hamburger Straße 287, 10:00–1:00
12 R. P. McMurphy (Irisch Pub), Bültenweg 10, 16:00–2:00
13 Pico's Bierladen (Türkisch), Bültenweg 6, 12:00–24:00
14 See Palast (Chinesisch), Gliesmaroderstraße 15, 11:30–15:00, 18:00–23:00
15 Teratai House (Indon.-Chin.), Wendenstraße 49/50, 12:00–15:00, 18:00–23:00
16 Viertel Nach (Bistro), Bültenweg 89, 9:00–2:00
× Die Okerbrücke ist bis Ende November 1998 nicht passierbar

Hauptvorträge

T. Bisztriczky (Calgary, Canada) : A survey of cyclic polytopes
V. Chepoi (Marseille, France) : Superconnected subsets of hypercubes
R. Diestel (Chemnitz, Germany) : Why is the tree-width of that graph large?
J. Pach (Budapest, Hungary) : Crossing numbers of graphs

Kurzvorträge

G. Agnarsson (Reykjavik, Iceland) : Asymptotic estimation on certain Product Ramsey Numbers
M. Atici (Bornova-Izmir, Turkey) : Unary and binary operations of graphs and their geodetic number
H.K. Aydinian (Bielefeld) : On perfect codes and related concepts
L. Babel (München) : Recognizing the P_4-structure of claw-free graphs
A. Baltz (Kiel) : Large h-Sidon sets in abelian groups
U. Baumann (Dresden) : Permutation groups and coloured graphs
S.L. Bezrukov (Paderborn) : A local-global principle for vertex-isoperimetric problems
J.-P. Bode (Braunschweig) : Knight independence on triangular hexagon boards
S. Böcker (Bielefeld) : Patching up X-trees
T. Böhme (Ilmenau) : Labeled $K_{2,t}$-minors in plane graphs
S. Brandt (Berlin) : Colouring dense triangle-free graphs
G. Brinkmann (Bielefeld) : Mathematics, chemistry and record hunting
D. Cieslik (Greifswald) : The Steiner ratio of metric spaces
M. Deza (Paris, France) : 4-dimensional fullerenes
B. Doerr (Kiel) : Linear and hereditary discrepancy
K. Dohmen (Berlin) : Ein Polynomzeit-Schema für das Prinzip der Inklusion-Exklusion
U. Eckhardt (Hamburg) : Root images of median filters
R. Elsässer (Paderborn) : The spider poset is Macaulay
I. Fabrici (Ilmenau) : Connected subgraphs with small degrees in polyhedral graphs
S. Felsner (Berlin) : Posets and planar graphs
D. Fronček (Ostrava-Poruba, Czech Republic) : 2-halvable complete 4-partite graphs
E. Gerbracht (Braunschweig) : Erweiterungen von C^*-Algebren via Erzeugender und Relationen
S. Gerke (Oxford, Great Britain) : Colouring weighted bipartite graphs with a co-site constraint
H. Gropp (Heidelberg) : On the life and combinatorial work of Levi and Steinitz
S. Grünewald (Bielefeld) : Chromatic-index critical graphs of even order
M. Grüttmüller (Rostock) : Nonexistence criteria for PBD's with block sizes 4 and k
S. Guttmann (Rostock) : Recognition of bandwidth-k k-connected graphs
A. Hackmann (Braunschweig) : Kantenfärbungen planarer Graphen
J. Harant (Ilmenau) : On lower bounds on independence
T. Harmuth (Bielefeld) : Enumeration of cubic toroidal maps
E. Harzheim (Düsseldorf) : Ein diskretes Analogon zum Begriff "rechtsseitiger Häufungspunkt"
H. Hassenpflug (Aachen) : Lineare homogene partielle Differenzengleichungen
C. Hendler (Berlin) : About the cliquecoveringnumber of boxgraphs
W. Imrich (Leoben, Austria) : Products of graphs
S. Jendroľ (Ilmenau) : Recent results on cyclic chromatic number of 3-connected planar graphs
M.J. Jiménez Rodrígues (Sevilla, Spain) : Discrete methods in algebraic topology
L.K. Jørgensen (Aalborg, Denmark) : Search for directed strongly regular graphs
M. Kochol (Berlin) : Hypothetical complexity of the nowhere-zero 5-flow problem
E. Köhler (Berlin) : Hamiltonian cycles in subclasses of AT-free graphs
V. Korzhyk (Chernovtsy, Ukraine) : On the 1-chromatic number of nonorientable surfaces
D. Kratsch (Jena) : Chordality and 2-factors in tough graphs
M. Kriesell (Berlin) : All 4-connected line graphs of claw free graphs are hamiltonian connected

R. Labahn (Rostock)	:	Construction methods for sparse gossip graphs
T. Lange (Braunschweig)	:	Factorization of polynomials over arbitrary finite fields
A. L. Larsen (Lyngby, Denmark)	:	Chip firing and Cayley's formula
U. Leck (Rostock)	:	Self-orthogonal Hamilton path decompositions of complete graphs
F. Luca (Bielefeld)	:	How palindromic are the rows of the Pascal triangle?
H. Mielke (Berlin)	:	Meanders
M. Naatz (Berlin)	:	The graph of linear extensions of a poset
U. von Nathusius (Bielefeld)	:	Generating 3-regular maps with given face sizes
D. Osthus (Berlin)	:	Sperner properties of random subsets of a finite set
T. Pisanski (Ljubljana, Slowenien)	:	Weakly flag-transitive configurations
A. Pönitz (Mittweida)	:	Automatische Erzeugung von Algorithmen zur Berechnung von Invarianten in Graphen beschränkter Breite
E. Prisner (Hamburg)	:	Intersection graphs of linear 3-uniform hypergraphs
J. Quistorff (Hamburg)	:	Über volle partielle Quasigruppen endlicher Ordnung
B. Randerath (Köln)	:	Colouring graphs with prescribed induced cycle lengths
D. Rautenbach (Aachen)	:	Embedding two edge-disjoint copies of a tree in a complete bipartite graph of the same order
A. Recski (Bonn)	:	Some new matroidal constructions on the edge set of graphs
H.-H. Scheel (Braunschweig)	:	Some geometric problems concerning algebraic linear programming
A. Schelten (Cottbus)	:	On multicolored Ramsey-numbers
I. Schiermeyer (Cottbus)	:	Cycles in Japan: Vertex-pancyclic graphs and cycle partitions
T. Schoen (Kiel)	:	On the density of sets containing no three distinct elements with all their sums
A. E. Schroth (Braunschweig)	:	How to draw a hexagon
M. Sonntag (Freiberg)	:	Antimagic vertex-labeling of hypergraphs
E. Steffen (Bielefeld)	:	About two conjectures of Vizing
T. Szymczak (Rostock)	:	The complexity of some problems related to graph 3-colorability
A. Taraz (Berlin)	:	The evolution of partially ordered sets
T. Tautenhahn (Magdeburg)	:	Dominance properties for sets of sequences
H.-M. Teichert (Lübeck)	:	The sum number of *d*-partite complete hypergraphs
M. Tewes (Aachen)	:	Cycles and indegrees of in-tournaments
P. Tittmann (Mittweida)	:	Reliability polynomials
U. Tönges (Bielefeld)	:	Coherence of metrics on six points
M. Voigt (Ilmenau)	:	Partial list colorings
G. Wesp (Salzburg, Austria)	:	Chirotopes and Pfaffians
P. Willenius (Magdeburg)	:	Dominance properties for sets of sequences
A. Winterhof (Braunschweig)	:	On the non-existence of generalized Hadamard matrices

Weitere Teilnehmer

P. Braß (Berlin), L. Danzer (Dortmund) W. Deuber (Bielefeld), J. Dochkova (Braunschweig), D. Dornieden (Braunschweig), A. Filip (Berlin), D. Gernert (München), J. Greinus (Bielefeld), H.-D. Gronau (Rostock), H. Harborth (Braunschweig), M. Harborth (Magdeburg), E. Hexel (Ilmenau), M. Höding (Magdeburg), T. Jensen (Chemnitz), C. Josten (Frankfurt), A. Kemnitz (Braunschweig), G. Laßmann (Berlin), R. Löwen (Braunschweig), I. Mengersen (Braunschweig), M. Möller (Braunschweig), N. Morawe (Berlin), B. Nitzsche (Berlin), H. Paschke (Bielefeld), A. Pruchnewski (Ilmenau), A. Rosa (Hamilton, Canada), E. Ruet d' Auteuil (Manitoba, Canada), Z. Ryjáček (Pilsen, Czech Republic), G. Sabidussi (Montreal, Canada), H. Sachs (Ilmenau), R. Stanton (Manitoba, Canada), P. Stark (Braunschweig), C. Thürmann (Braunschweig), L. Volkmann (Aachen), H. Walther (Ilmenau), B. Wegner (Berlin), H. Weiß (Braunschweig), G. Zesch (Berlin)

A survey of cyclic polytopes

TIBOR BISZTRICZKY
Departement of Mathematics
Universitity of Calgary, Canada

In recent years, cyclic polytopes have become increasing useful in various branches of the mathematical sciences due to the fact that they are descibable and that they possess certain extremal properties. We introduce the theory of these polytopes, and examine some applications in the fields of Discrete and Combinatorial Geometry.

Superconnected subsets of hypercubes

V. Chepoi (LIM, Université d'Aix-Marseille II)
(join work with H.-J. Bandelt, A. Dress and J. Koolen)

Given any subset Y of of a finite set X, one can always associate two subsets $\mathcal{S}_Y$ and $\mathcal{S}^Y$ of $\{\pm 1\}^{X-Y}$ with an arbitrary set $\mathcal{S} \subseteq \{\pm 1\}^X$ of sign maps:

$$\mathcal{S}_Y := \{t \in \{\pm 1\}^{X-Y} \mid \text{some extension } s \in \{\pm 1\}^X \text{ of } t \text{ belongs to } \mathcal{S}\},$$

$$\mathcal{S}^Y := \{t \in \{\pm 1\}^{X-Y} \mid \text{every extension } s \in \{\pm 1\}^X \text{ of } t \text{ belongs to } \mathcal{S}\}.$$

These operations suggest two ways to derive a simplicial complex from $\mathcal{S}$:

$$\overline{\mathcal{X}}(\mathcal{S}) := \{Y \subseteq X \mid \mathcal{S}_{X-A} = \{\pm 1\}^Y\},$$

$$\underline{\mathcal{X}}(\mathcal{S}) := \{Y \subseteq X \mid \mathcal{S}^Y \neq \emptyset\}.$$

One observes that

$$\#\underline{\mathcal{X}}(\mathcal{S}) \leq \#\mathcal{S} \leq \#\overline{\mathcal{X}}(\mathcal{S})$$

must always hold in this case. So, it appears to be natural to call the set $\mathcal{S}$ "ample" if the equality $\#\mathcal{S} = \#\overline{\mathcal{X}}(\mathcal{S})$ holds, which in turn can be shown to be equivalent to $\underline{\mathcal{X}}(\mathcal{S}) = \overline{\mathcal{X}}(\mathcal{S})$. Ampleness is preserved when passing to the sets $\mathcal{S}^Y$ and $\mathcal{S}_Y$. Every ample set $\mathcal{S}$ induces a connected (even more, an isometric) subgraph of the hypercube $\{\pm 1\}^X$, and hence $\mathcal{S}_Y$ and $\mathcal{S}^Y$ are connected (isometric) subgraphs of the factor hypercube $\{\pm 1\}^{X-Y}$. Conversely, connectivity (or isometricity) of $\mathcal{S}^Y$ for all $Y \subseteq X$ implies ampleness, and therefore ample sets may equally be called *superconnected* or *superisometric.* Studying ample sets in more detail, it turned out that our ample sets coincide exactly with Lawrence's lopsided sets and that an amazingly rich multi–facetted theory of such sets could be developed. Here is a list of some of the most remarkable properties which characterize such sets and hence could be used to define them:

superconnectivity: $\mathcal{S}^Y$ is connected for all $Y \subseteq X$,

superisometry: $\mathcal{S}^Y$ is isometric for all $Y \subseteq X$,

commutativity: $(\mathcal{S}^Y)_Z = (\mathcal{S}_Z)^Y$ holds for all disjoint subsets Y, Z of X,

ampleness: $\#\mathcal{S} = \#\overline{\mathcal{X}}(\mathcal{S})$,

lopsidedness: there is no $Y \subseteq X$ with $Y \in \overline{\mathcal{X}}(\mathcal{S})$ and $X - Y \in \overline{\mathcal{X}}(\{\pm 1\}^X - \mathcal{S})$.

There are also recursive criteria, which allow to recognize in polynomial time (relative to $\#\mathcal{S}$) whether or not a set $\mathcal{S}$ of sign maps is superconnected. Superconnected sets $\mathcal{S}$ are naturally described in terms of the maximal faces (subhypercubes) of $\mathcal{S}$; encoded by their respective barycenters in R^X, they form what we call the *barycentric skeleton* of $\mathcal{S}$. When instead every (maximal) face of $\mathcal{S}$ is enlarged to its convex hull in R^X (that is, all graphical hypercubes in $\mathcal{S}$ are turned into solid hypercubes), one obtains the *geometric realization* $|\mathcal{S}|$ of $\mathcal{S}$. Then superconnectivity is equivalent to the following property:

l_1-isometry: $|\mathcal{S}|$ endowed with the intrinsic path-metric is a metric subspace of the l_1-space R^X.

Why is the tree-width of that graph large?

REINHARD DIESTEL

Convincing somebody that a given graph has small tree-width is relatively easy: all we have to do is present a tree-decomposition into small enough parts. (Warm-up exercise for this talk: how does one 'present' a tree-decomposition convincingly, i.e. so that it is easily checked to be a tree-decomposition of the graph in question?) But how can we persuade someone that a given graph has *large* tree-width?
In this talk, we shall survey a few of the best known 'certificates' for large tree-width. The most fundamental of these, in the sense that its existence easily implies that of all the others but not conversely, is a large grid minor. The occurrence of large grid minors in graphs of high tree-width is also central to the proof Robertson and Seymour's Graph Minor Theorem, since it implies the following:
Theorem 12.4.4. (Robertson & Seymour, 1986)
The tree-width of the graphs without an X minor is bounded if and only if X is planar.

In the second half of the talk, I will indicate a short proof of this result obtained recently with K.Yu. Gorbunov, T.R. Jensen and C. Thomassen.

Crossing Numbers of Graphs

János Pach[1]

A *drawing* of a graph G is a representation of G in the plane such that its vertices are represented by distinct points and its edges by simple continuous arcs connecting the corresponding point pairs. If it is clear whether we talk about the "abstract" graph G or its planar representation, these points and arcs will also be called vertices and edges, respectively. For simplicity, we assume that in a drawing (a) no edge passes through any vertex other than its endpoints, (b) no two edges touch each other (i.e., if two edges have a common interior point, then at this point they properly cross each other), and (c) no three edges cross at the same point.

Turán defined the *crossing number* of G, $\text{CR}(G)$, as the smallest number of edge crossings in any drawing of G. Clearly, $\text{CR}(G) = 0$ if and only if G is planar. According to a famous conjecture of Zarankiewicz, the crossing number of the complete graph $K_{n,m}$ with n and m vertices in its classes satisfies

$$\text{CR}(K_{n,m}) = \lfloor\frac{m}{2}\rfloor \cdot \lfloor\frac{m-1}{2}\rfloor \cdot \lfloor\frac{n}{2}\rfloor \cdot \lfloor\frac{n-1}{2}\rfloor.$$

Garey and Johnson proved that the determination of the crossing number is an *NP-complete* problem. In the past twenty years, it turned out that crossing numbers play an important role in various fields of discrete and computational geometry, and they can also be used, e.g.,to obtain lower bounds on the chip area required for the VLSI circuit layout of a graph. In this lecture, first we recall two important general results for crossing numbers (see below), and outline some of their applications. Next we describe some recent extensions and generalizations of these theorems. After that we introduce three alternative notions of crossing number, and analyze their relationship. Finally, we state some tantalizing open problems.

The first general result was proved by Ajtai–Chvátal–Newborn–Szemerédi and, independently, by Leighton. The best known constant, 1/33.75, in the theorem is due to Pach and Tóth.

Theorem 1. *For any graph G with n vertices and $e \geq 4n$ edges, we have*

$$\text{CR}(G) \geq \frac{1}{33.75}\frac{e^3}{n^2},$$

and this estimate is tight up to a constant factor.

To state the second general bound on the crossing number, we need a definition. Let G be a graph with vertex set $V(G)$ and edge set $E(G)$. The *bisection width* of G, $b(G)$, is defined as the minimum number of edges, whose removal splits the graph into two roughly equal subgraphs. More precisely, $b(G)$ is the minimum number of edges running between V_1 and V_2, over all partitions of the vertex set of G into two disjoint parts $V_1 \cup V_2$ such that $|V_1|, |V_2| \geq |V(G)|/3$.

Leighton observed that there is an intimate relationship between the bisection width and the crossing number of a graph, which is based on the Lipton–Tarjan separator theorem for planar graphs. The following version of this relationship was obtained by Pach, Shahrokhi, and Szegedy.

Theorem 2. *Let G be a graph of n vertices with degrees $d_1, d_2, \ldots, d_n$. Then*

$$b(G) \leq 10\sqrt{\text{CR}(G)} + 2\sqrt{\sum_{i=1}^{n} d_i^2}.$$

[1]Mathematical Institute of the Hungarian Academy of Sciences, H-1364 Budapest, Pf. 127, Hungary, and Courant Institute, New York. E-mail: pach@math-inst.hu

Freitag, 13.11.1998 — Zeit: 13.30

1 — Sektion I — Raum PK 14.3 — 13.30

Reliability Polynomials

PETER TITTMANN
Hochschule Mittweida
Fachbereich Mathematik / Physik / Informatik

The reliability polynomial $R(G, p)$ is the probability that an undirected graph $G = (V, E)$ is connected assuming all edges of G fail independently with probability $1 - p$. This polynomial is closely related to the Tutte polynomial of G. It can be shown that the partition lattice of the vertex set of G permits more general representations of $R(G, p)$ including the K-terminal reliability of G. Polynomial algorithms for recurrent graph structures are obtained by investigating partitions and labelled partitions of separating vertex sets of G. This approach requires for a grid graph $G_{m,n}$ the computation of a square matrix of order $\min(s(m), s(n))$ where $s(r)$ is derived from the number of symmetric noncrossing partitions of a r-set.

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2 — Sektion II — Raum PK 14.4 — 13.30

About two conjectures of Vizing

ECKHARD STEFFEN
Bielefeld

In 1968, Vizing made the following two conjectures for graphs which are critical with respect to the chromatic index: (1) every critical graph has a 2-factor, and (2) every independent vertex set in a critical graph contains at most half of the vertices.

We prove both conjectures for critical graphs with many edges, and determine two different types of upper bounds for the size of independent vertex sets in those graphs.

3 — Sektion III — Raum PK 14.6 — 13.30

All 4-connected line graphs of claw free graphs are hamiltonian connected

MATTHIAS KRIESELL

THOMASSEN conjectured that every 4-connected line graph is hamiltonian. Here we shall see that 4-connected line graphs of claw free graphs are hamiltonian connected.

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4 — Sektion IV — Raum PK 14.7 — 13.30

Knight Independence on Triangular Hexagon Boards

JENS-P. BODE
Rebenring 62, D-38106 Braunschweig

The maximum number of pairwise nonattacking knights (independence number) β_n on equilateral triangular boards T_n of regular hexagons is determined for all n.

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5 — Sektion V — Raum PK 14.8 — 13.30

Chordality and 2-factors in tough graphs

DIETER KRATSCH
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A graph G is *chordal* if it contains no chordless cycle of length at least four and is *k-chordal* if a longest chordless cycle in G has length at most k. A graph G is *t-tough* if $|S| \geq t \cdot \omega(G - S)$ for every subset S of the vertex set V of G with $\omega(G - S) > 1$, where $\omega(G - S)$ denotes the number of components of $G - S$. A *2-factor* of a graph G is a 2-regular spanning subgraph of G.

We show that all $\frac{3}{2}$-tough 5-chordal graphs have a 2-factor. This result is best possible in two ways. Examples due to Chvátal show that for all $\epsilon > 0$ there exists a $(\frac{3}{2} - \epsilon)$-tough chordal graph with no 2-factor. Furthermore, examples due to Bauer and Schmeichel show that the result is false for 6-chordal graphs. As a consequence we completely determine those pairs (k, t) for which every t-tough k-chordal graph has a 2-factor.

Freitag, 13.11.1998 — Zeit: 14.00

6 — Sektion I — Raum PK 14.3 — 14.00

Ein Polynomzeit-Schema für das Prinzip der Inklusion-Exklusion

KLAUS DOHMEN
Humboldt-Universität zu Berlin

Wir präsentieren eine neue Variante des Prinzips der Inklusion-Exklusion und zeigen, wie sich der Zeitaufwand unter gewissen Voraussetzungen durch ein Polyno m in der Anzahl der beteiligten Mengen nach oben beschränken läßt.

Literatur: K. Dohmen, Inclusion-exclusion and network reliability, *Electr on. J. Combin.* 5 (1998), paper no. 36. [Internet: `http://www.com binatorics.org`]

7 — Sektion II — Raum PK 14.4 — 14.00

Colouring weighted bipartite graphs with a co-site constraint*

STEFANIE N.T. GERKE
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We will discuss a problem of assigning numbers to the vertices of a bipartite graph, so that w_v numbers (or colours) are to be assigned to each vertex v. Numbers assigned to a given vertex must be at least k_0 apart from each other, and numbers assigned to adjacent vertices must differ by at least k_1. The objective is to minimise the span, i.e. the difference between the greatest and smallest number used for the assignment. This problem is motivated by frequency spectrum management. We shall introduce fast algorithms which find optimal assignments with respect to the span if $k_0 = k_1$, $k_0 = 2k_1$ or $k_0 \geq 3k_1$.

*This work was partly supported by EPSRC under grant 97004215

8 — Sektion III — Raum PK 14.6 — 14.00

Cycles in Japan: Vertex-pancyclic graphs and cycle partitions

INGO SCHIERMEYER
TU Cottbus

A graph G is called *vertex-pancyclic* if each vertex $v \in V(G)$ is contained in a cycle of length k for $3 \leq k \leq n$.

Theorem (Randerath, Schiermeyer, Tewes, Volkmann, '97)
If $C_{\frac{4n-3}{3}}(G)$ is complete (Bondy-Chvátal closure), then G is vertex-pancyclic.

For any set of k fixed vertices $x_1, x_2, \ldots, x_k$ a collection of k vertex-disjoint cycles is called a *k-cycle packing* (*k-cycle partition*) of G if $x_i \in V(C_i)$ for $1 \leq i \leq k$ (and $V(G) = \cup_{i=1}^{k} V(C_i)$).

Theorem (Enomoto, Schiermeyer, '98)
If $\delta(G) \geq max\{3k-1, \frac{n}{2}\}$ then G has a k-cycle partition.

For both theorems we will present sharpness examples and related results.

9 — Sektion IV — Raum PK 14.7 — 14.00

Connected subgraphs with small degrees in polyhedral graphs

IGOR FABRICI, ERHARD HEXEL, HANSJOACHIM WALTHER
TU Ilmenau

We consider the following problem:

Problem. Let $k \geq 1$ be an integer and let $\mathcal{G}$ be a family of polyhedral graphs with at least one member of order at least k. What is the smallest integer $\tau(\mathcal{G}, k)$ such that every graph $G \in \mathcal{G}$ of order at least k contains a connected subgraph H of order k with

$$\deg_G(x) \leq \tau(\mathcal{G}, k), \text{ for every vertex } x \in V(H)?$$

Moreover, we present, for some special families $\mathcal{G}$ of polyhedral graphs, lower and upper bounds for $\tau(\mathcal{G}, k)$.

10 — Sektion V — Raum PK 14.8 — 14.00

Recognition of bandwidth-k k-connected graphs

SVEN GUTTMANN
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A graph $G = (V, E)$ has bandwidth k if there exists a bijective mapping $f : V \rightarrow \{1, \ldots, |V|\}$ such that $\max\{|f(u) - f(v)| : vw \in E\} = k$. It is known that the BANDWIDTH problem is NP-complete. A graph G is k-connected, if k is the smallest number such that there exists a subset V' of V with $|V'| = k$ and $G \setminus V'$ is disconnected. It will be presented a linear-time algorithm to decide whether a given graph G is a bandwidth-k k-connected graph or not and if so a $bw - k$ layout is given.

Freitag, 13.11.1998 — Zeit: 14.30

11 — Sektion I — Raum PK 14.3 — 14.30

Nonexistence criteria for PBD's with block sizes 4 and k

MARTIN GRÜTTMÜLLER
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A pairwise balanced design $PBD[v, K]$ of order v with block sizes from K is a pair $(V, \mathcal{B})$, where V is a finite set (the point set) of cardinality v and $\mathcal{B}$ is a family of subsets of V called blocks such that every 2-subset of V is contained in exactly one block of $\mathcal{B}$, and $|B| \in K$ for every block $B \in \mathcal{B}$.

In this talk, we examine existence criteria for PBD's with block sizes 4 and k.

12 — Sektion II — Raum PK 14.4 — 14.30

Kantenfärbungen planarer Graphen

ANDREA HACKMANN

Der listenchromatische Index $\mathrm{ch}'(G)$ eines Graphen G ist die kleinste Zahl k, so daß für jede Zuordnung von k-elementigen Farblisten $L(e)$ zu den Kanten von G eine Kantenfärbung des Graphen existiert, bei der jede Kante eine Farbe aus der dazugehörigen Liste erhält. Die listenkantenchromatische Vermutung besagt, daß der listenchromatische Index für jeden Graphen G gleich dem chromatischen Index ist, also $\mathrm{ch}'(G) = \chi'(G)$. Bisher konnte diese Vermutung nur für wenige Klassen von Graphen bestätigt werden, wie zum Beispiel für bipartite Graphen, vollständige Graphen mit ungerader Knotenzahl oder planare Graphen mit Maximalgrad $\Delta \geq 12$. Im Vortrag werden einige Ergebnisse der Kanten- und Listenkantenfärbung vorgestellt sowie die listenkantenchromatische Vermutung für outerplanare Graphen mit Maximalgrad $\Delta \geq 5$ bewiesen.

13 — Sektion III — Raum PK 14.6 — 14.30

Recognizing the P_4–structure of claw–free graphs

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The P_4–structure of a graph G is a hypergraph $\mathcal{H}$ on the same vertex–set such that four vertices form a hyperedge in $\mathcal{H}$ whenever they induce a P_4 in G. We present a constructive algorithm which tests in polynomial time whether a given 4–uniform hypergraph is the P_4–structure of a claw–free graph. The algorithm relies on new structural results for claw–free graphs which are based on the concept of p–connectedness. As a byproduct, we obtain a criterion for perfectness for a large class of graphs.

14 — Sektion IV — Raum PK 14.7 — 14.30

Unary and Binary Operations of Graphs and Their Geodetic Number

MUSTAFA ATICI
International Computer Institute, Ege University

The distance $d(u, v)$ between two vertices u and v in a connected graph G is the length of shortest $u - v$ path in G. A $u - v$ path of length $d(u, v)$ is called a $u - v$ *geodesic.* We define $H(u, v)$ to be the set of all vertices lying on some $u - v$ geodesic of G, and for a nonempty subset S of $V(G)$,

$$H(S) = \bigcup_{u,v \in S} H(u, v).$$

A set S of vertices of G is defined to be *geodetic set* in G if $H(S) = V(G)$, and a geodetic set of minimum cardinality is a *minimum geodetic set.* The cardinality of a minimum geodetic set in G is the *geodetic number* $g(G)$. We compute the geodetic number of graphs obtained via various operations. These operations are unary, such as complements and powers, and binary, composition, join and product. In some cases we only determine upper bound for the geodetic number of graphs.

15 — Sektion V — Raum PK 14.8 — 14.30

The Complexity of some problems related to GRAPH 3-COLORABILITY

ANDREAS BRANDSTÄDT, VAN BANG LE AND THOMAS SZYMCZAK
Universität Rostock, Fachbereich Informatik, Institut für Theoretische Informatik,
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It is well-known that the GRAPH 3–COLORABILITY problem, deciding whether a given graph has a stable set whose deletion results in a bipartite graph, is NP–complete. We prove the following related theorems: It is NP–complete to decide whether a graph has a stable set whose deletion results in (1) a tree or (2) a trivially perfect graph, and there is a polynomial algorithm to decide if a given graph has a stable set whose deletion results in (3) the complement of a bipartite graph, (4) a split graph or (5) a threshold graph.

Freitag, 13.11.1998 — Zeit: 15.00

16 — Sektion I — Raum PK 14.3 — 15.00

Chip Firing and Cayley's formula

AHN LOUISE LARSEN
Dept. of Mathematics, Technical University of Denmark

The chip firing game is a solitaire game played on an undirected connected graph G. A number of chips is distributed on the vertices of G, and a chip is moved from one vertex to another according to certain rules. A distribution of chips is called a configuration.

A variant of the chip firing game called the dollar game was studied by Biggs. Certain configurations in the dollar game are said to be critical. It turns out that the generating function for these critical configurations is an evaluation of the Tutte polynomial of the graph. A consequence of this is that the number of critical configurations equals the number of spanning trees in the graph. This fact has led to a new short proof of Cayley's formula for the number of spanning trees in the complete graph.

17 — Sektion II — Raum PK 14.4 — 15.00

Colouring dense triangle-free graphs

STEPHAN BRANDT
Freie Universität Berlin

In 1973, Erdős and Simonovits conjectured that the minimum degree of any triangle-free graph of order n with chromatic number more than 3 is at most $(1 + o(1))n/3$. This conjecture was refuted by Häggkvist, who constructed a sequence of triangle-free 4-chromatic graphs with minimum degree $10n/29$. Motivated by this result, Guoping Jin conjectured that there are sequences of t-chromatic graphs with minimum degree at least $c_t n$ with $c_t > 1/3$ for arbitrarily large t. The truth of this conjecture would contradict the Erdős-Simonovits conjecture completely. We believe that the Erdős-Simonovits conjecture holds with chromatic number more than 4 in place of 3, and we give support to this conjecture by showing that it is valid restricted to regular maximal triangle-free graphs:

Every d-regular maximal triangle-free graph with $d > n/3$ is 4-colourable.

18 — Sektion III — Raum PK 14.6 — 15.00

Hamiltonian Cycles in Subclasses of AT–free Graphs

EKKEHARD KÖHLER, BERLIN
MATTHIAS KRIESELL, HANNOVER

The HAMILTONIAN CYCLE problem is one of the most challenging problems in the field of algorithmic graph theory. Even for line graphs the problem is NP–complete but if we restrict the input to some special graph classes, as for example interval graphs or cocomparability graphs, one can find polynomial time algorithms. For the class of AT–free graphs it is still open if there is an efficient algorithm.

In this talk we deal with the HAMILTONIAN PATH and CYCLE problem restricted to certain graph classes, related to AT–free graphs. We are especially interested in AT–free claw–free graphs and line graphs of AT–free graphs. We show some structural results for these classes and present linear time algorithms for both problems when the input is restricted to claw–free graphs, containing a dominating pair.

19 — Sektion IV — Raum PK 14.7 — 15.00

Automatische Erzeugung von Algorithmen zur Berechnung von Invarianten in Graphen beschrankter Breite

ANDRÉ POENITZ
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Vorgestellt wird eine allgemeine Methode, die ausgehend von rekursiven Beschreibungen von Grapheninvarianten Algorithmen zur ihrer Berechnung erzeugt. Die so entstehenden Algorithmen sind - je nach konkreter Invariante - oft polynomial oder gar linear in Laufzeit und Speicherverbrauch für Graphen beschränkter Breite, und erlauben damit die Berechnung von Graphen die aus Modellen realer Anwendungen stammen.

Die prinzipielle Funktionsweise der Algorithmen wird anhand eines konkreten Beispiels beschrieben; und darauf aufbauend die allgemeine Methode entwickelt. Praktische Ergebnisse werden zum Abschluß vorgestellt.

20 — Sektion V — Raum PK 14.8 — 15.00

Patching up X-trees

SEBASTIAN BÖCKER, ANDREAS W.M. DRESS, AND MIKE A. STEEL
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Given a collection $\mathcal{T}$ of leaf labeled trees (with distinct, though not necessarily disjoint label sets), one might ask if there exists a leaf labeled "parent tree" T such that all trees in $\mathcal{T}$ are "induced" subtrees of T, and if this tree T is uniquely determined. Even the first problem is known to be NP-complete in general, where we may assume—without loss of generality—that all trees in $\mathcal{T} = \mathcal{T}_4$ have precisely four leaves.

It is easy to see that for T to be uniquely determined by $\mathcal{T}_4$, there must be at least $n-3$ trees in $\mathcal{T}_4$ if there are exactly n labels used altogether in $\mathcal{T}_4$; such collections of four-leaf trees will be called *excess free*. We obtain a full characterization of such sets $\mathcal{T}_4$, which exploits an underlying "patchwork" structure of the excess free subsets of $\mathcal{T}_4$—where a collection $\mathcal{C}$ of subsets of a set X is called a *patchwork* if "$A, B \in \mathcal{C}$ and $A \cap B \neq \emptyset \Rightarrow A \cap B, A \cup B \in \mathcal{C}$" holds. Using this approach, we obtain a polynomial time algorithm for certain instances of the problem of reconstructing trees from subtrees.

Freitag, 13.11.1998 — Zeit: 15.30

21 — Sektion I — Raum PK 14.3 — 15.30

How palindromic are the rows of the Pascal triangle?

Florian Luca

Take the $n+1$'th row of the Pascal triangle and write every member of it in your favorite base b (here, b is an integer such that $b > 1$). The question that we investigate is the following:

When is the resulting string of digits a palindrome?

For example, when $b = 6$ and $n = 7$ the resulting string of digits is

1 11 33 55 33 11 1

which is a palindrome.

A quick inspection of the first few values of n and b reveals that this phenomenon does not occur too often. In fact, we can prove the following:

Theorem. *If n is such that the $n+1$'th row of the Pascal triangle is a digital base b palindrome, then $n < b$ when $b \neq 2, 4, 6$ and $n \leq b+1$ when $b = 2, 4, 6$.*

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22 — Sektion II — Raum PK 14.4 — 15.30

Colouring Graphs with Prescribed Induced Cycle Lengths

BERT RANDERATH (Universität zu Köln), INGO SCHIERMEYER (BTU Cottbus)

It is due to Sumner that triangle-free and P_5-free or triangle-free, P_6-free and C_6-free graphs are 3-colourable. A canonical extension of these graph classes is $\mathcal{G}^I(4,5)$, the class of all graphs whose induced cycle lengths are 4 or 5. [Subclass $\mathcal{G}^I(4) \simeq$ chordal bipartite graphs.] Our main result states that all graphs of $\mathcal{G}^I(4,5)$ are 3-colourable. Moreover, all triangle-free graphs G of this kind, i. e. $G \in \mathcal{G}^I(n_1, n_2)$ with $n_1, n_2 \geq 4$, are 3-colourable. It is noteworthy that the proofs of our results have algorithmic impact.
Furthermore, we consider the related problem of finding a χ-binding functions for the class $\mathcal{G}^I(n_1, n_2)$. Because of our previous results we only have to consider $\mathcal{G}^I(3, n)$. Recently, Rusu proved that all graphs of $\mathcal{G}^I(3, 2q)$ are perfect ($f(\omega) = \omega$) for any $q \geq 3$. [Subclass $\mathcal{G}^I(3) \simeq$ chordal graphs.] Gyárfás conjectured in 1987, motivated by the Strong Perfect Graph Conjecture, that there exists a χ-binding function for $\mathcal{G}^I(3,4)$. We have shown that there exists no linear χ-binding function for $\mathcal{G}^I(3,4)$. For the remaining case n odd we expect that there exists a linear χ-binding function for $\mathcal{G}^I(3, 2p+1)$.

23 — Sektion III — Raum PK 14.6 — 15.30

Self-orthogonal Hamilton path decompositions of complete graphs

UWE LECK
Uni Rostock

A self-orthogonal decomposition of K_n into Hamiltonian paths is a collection $\mathcal{P} = \{P_1, P_2, \ldots, P_n\}$ of paths such that:
(1) P_i is a spanning subgraph of K_n for all i,
(2) P_i and P_j share exactly one edge for all $i \neq j$,
(3) every edge of K_n is contained in exactly two members of $\mathcal{P}$.

It is conjectured that a self-orthogonal decomposition of K_n into Hamiltonian paths exists iff $n \neq 4$. We will present a new construction which yields solutions for large classes of parameters n.

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24 — Sektion IV — Raum PK 14.7 — 15.30

2-halvable complete 4-partite graphs

DALIBOR FRONČEK
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A complete 4-partite graph K_{m_1,m_2,m_3,m_4} is called d-halvable if it can be decomposed into two isomorphic factors of diameter d. In the class of graphs K_{m_1,m_2,m_3,m_4} with at most one odd part all d-halvable graphs are known. In the class of biregular graphs K_{m_1,m_2,m_3,m_4} with four odd parts (i.e., the graphs $K_{m,m,m,n}$ and $K_{m,m,n,n}$) all d-halvable graphs are known as well, except for the graphs $K_{m,m,n,n}$ when $d = 2$ and $n \neq m$. We prove that such graphs are 2-halvable iff $n, m \geq 3$. We also determine two new classes of non-halvable graphs K_{m_1,m_2,m_3,m_4} with three or four different odd parts.

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25 — Sektion V — Raum PK 14.8 — 15.30

About the cliquecoveringnumber of boxgraphs

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A class of graphs $\mathcal{G}$ is said to be θ-bound with θ-binding f unction f if $\theta(G) \leq f(\alpha(G))$ holds for all graphs $G \in \mathcal{G}$, where $\theta(G)$ is the cliquecoveringnumber and $\alpha(G)$ the independen cenumber of G. A d-dimensional Box-Graph is an intersectiongraph of boxes in the d-dimensional Euclidean space, where the boxes are parallelopipeds with s ides parallel to the coordinate axes. The best previously known θ-binding function for the class of d-dimensional boxgraphs was $f(\alpha) = \alpha^d$, w hich I'll improve to $f(\alpha) = \alpha\,(\log(\alpha) + 1)^{d-1}$.

Freitag, 13.11.1998 — Zeit: 16.30

26 — Sektion I — Raum PK 14.3 — 16.30

Enumeration of Cubic Toroidal Maps

THOMAS HARMUTH

In this talk I will give an inductive definition of the class of all simple cubic toroidal maps (SCT–maps) where toroidal maps are maps which are embedded in the torus. The inductive definition has been used to implement an algorithm which enumerates all SCT–maps with a given vertex number. The resulting computer program generates about 5000 maps per second on a DEC Alpha computer.

27 — Sektion II — Raum PK 14.4 — 16.30

Chromatic-index critical graphs of even order

STEFAN GRÜNEWALD
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A multigraph M with maximum degree $\Delta(M)$ is called critical, if the chromatic index $\chi'(M) > \Delta(M)$ and $\chi'(M-e) = \chi'(M)-1$ for each edge e of M. The weak critical graph conjecture by Chetwynd and Wilson claims that there exists a constant $c > 0$ such that every critical multigraph M with at most $c \cdot \Delta(M)$ vertices has odd order. We disprove this conjecture by constructing critical multigraphs of order 20 with maximum degree k for all $k \geq 5$.

28 — Sektion III — Raum PK 14.6 — 16.30

On lower bounds on independence

JOCHEN HARANT
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Lower bounds on the independence number of a graph are established and accompanying efficient algorithms constructing an independent vertex set the cardinality of which is at least the considered lower bound are given.

29 — Sektion IV — Raum PK 14.7 — 16.30

A Local-global Principle for Vertex-Isoperimetric Problems

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We consider the shadow minimization problem (SMP) for cartesian powers P^n of a Macaulay poset P. We prove a local-global principle with respect to the lexicographic order $\mathcal{L}^n$. Namely, we show that under certain conditions the shadow of any initial segment of the order $\mathcal{L}^n$ for $n \geq 3$ is minimal iff it is so for $n = 2$. These conditions include such poset properties as *additivity*, *shadow increasing*, *final shadow increasing* and being *rank-greedy*. We show that these conditions are essentially necessary for the lexicographic order to provide nestedness in the SMP. We also present similar results on vertex-isoperimetric problems on graphs.

30 — Sektion V — Raum PK 14.8 — 16.30

Antimagic vertex–labeling of hypergraphs

MARTIN SONNTAG
TU Bergakademie Freiberg

It is known that special classes of uniform hypergraphs (e.g. uniform *hypercacti*) are *antimagic* (i.e. all hypergraphs of this class have an antimagic vertex–labeling). In the non–uniform case this question seems to be more complicated.

A (d_1, d_2)–uniform *hyperwheel* consists of a d_2–uniform cycle (the *rim* of the hyperwheel) with s vertices and, additionally, s pairwise distinct d_1–uniform edges (*spokes*) connecting the vertices of the rim with the center (*hub*) of the hyperwheel.

Obviously, $(2, 2)$–uniform hyperwheels (i.e. wheels) are not antimagic. We proof constructively that (d_1, d_2)–uniform hyperwheels are antimagic, if at least one of d_1 and d_2 is greater than 2.

Freitag, 13.11.1998 — Zeit: 17.00

31 — Sektion I — Raum PK 14.3 — 17.00

Meanders

HANS MIELKE
Freie Universität Berlin

MATTHIAS WOLFRUM
Weierstraß Institut Berlin

Meanders are simple geometric objects, defined as follows: Fix a line in the plane and n points on it. Consider a Jordan curve intersecting the line transversally in exactly these points. The equivalence class of such curves with respect to isotopies of the plane leaving the line fixed is called a meander of order n. (Every meander with n crossings can be viewed as a permutation of S_n.) We are especially interested in the set of positive meanders, whose winding number is nonnegative at each crossing. This subclass which is exponentially large arises from boundary value problems for ordinary differential equations.

The main result deals with the possible upper and lower completions for a prescribed vector of winding numbers assigned to the crossing points. We obtain a simple algorithm for the enumeration of positive meanders.

32 — Sektion II — Raum PK 14.4 — 17.00

On the 1-chromatic number of nonorientable surfaces

VOLODYMYR P. KORZHYK
Ukraine

Let $\chi_1(N_q)$ be the maximum chromatic number for all graphs which can be drawn on a nonorientable surface N_q ($q \geq 1$) so that each edge is crossed by no more than one other edge. It s proved that $R(N_q) - 2 \leq \chi_1(N_q)$ for $q \geq 208344$, where $R(N_q) = \lfloor \frac{1}{2}(9 + \sqrt{32q + 17}) \rfloor$ is Ringel's upper bound for $\chi_1(N_q)$. It is shown that $R(N_q) - 1 \leq \chi_1(N_q)$ for about $\frac{3}{4}$ of all nonorientable surfaces N_q. The exact value of $\chi_1(N_q)$ is found for about $\frac{1}{3}$ of all nonorientable surfaces N_q.

33 — Sektion III — Raum PK 14.6 — 17.00

Dominance Properties for Sets of Sequences

Thomas Tautenhahn
Per Willenius

We extend the concept of irreducibility of sequences arising in scheduling theory in the following way: Let $M(G)$ be the set of all acyclic orientations of an undirected graph G. A set $U(G) \subseteq M(G)$ is called *potentially optimal* if for each choice of vertex weights there is a digraph $A \in U(G)$ with the property that the maximal path weight of A is not bigger than the maximal path weight of any other digraph $B \in M(G)$. We examine minimal potentially optimal sets $U(G)$ for the case that $G = K_n \times K_m$. This leads to the problem of finding a minimal dominating set in a directed hypergraph.

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34 — Sektion IV — Raum PK 14.7 — 17.00

Cycles and indegrees of in-tournaments

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An in-tournament is an oriented graph such that the negative neighborhood of every vertex induces a tournament. In transfering the general adjacency to only those vertices that have a common positive neighbor, this class of digraphs form an interesting generalization of tournaments. The talk deals with the influence, the minimum indegree has on the cycle structure of an in-tournament D of order n. We consider aspects concerning the existence and the extendability of cycles such as k-pancyclicity (where, for some $3 \leq k \leq n$, D has a cycle of length t for every $k \leq t \leq n$) and pancyclic orderability (where the vertex set of D can be ordered such that for every $3 \leq t \leq n$, the first t vertices are the vertex set of a cycle of length t). We give lower bounds for the minimum indegree ensuring that an in-tournament has one of these properties. All the bounds presented here are best possible.

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35 — Sektion V — Raum PK 14.8 — 17.00

The sum number of d–partite complete hypergraphs

HANNS-MARTIN TEICHERT
Institute of Mathematics, Medical University of Lübeck

A d–uniform hypergraph $\mathcal{H}$ is a *sum hypergraph* iff there is a finite $S \subset \mathbb{N}^+$ such that $\mathcal{H}$ is isomorphic to the hypergraph $\mathcal{H}_d^+(S) = (V, \mathcal{E})$ where $V = S$ and $\mathcal{E} = \{\{v_1, \ldots, v_d\} : (i \neq j \Rightarrow v_i \neq v_j) \wedge \sum_{i=1}^{d} v_i \in S\}$. or an arbitrary d–uniform hypergraph $\mathcal{H}$ the *sum number* $= \sigma(\mathcal{H})$ is defined to be the minimum number of isolated vertices $w_1, \ldots, w_\sigma \notin V$ such that $\mathcal{H} \cup \{w_1, \ldots, w_\sigma\}$ is a sum hypergraph. We prove that

$$\sigma(\mathcal{K}^d_{n_1,\ldots,n_d}) = 1 + \sum_{i=1}^{d}(n_i - 1) + \min\left\{0, \left\lceil \frac{1}{2}\left(\sum_{i=1}^{d-1}(n_i - 1) - n_d\right)\right\rceil\right\},$$

where $\mathcal{K}^d_{n_1,\ldots,n_d}$ denotes the d-partite complete hypergraph; this generalizes the corresponding result of Hartsfield and Smyth (1992) for complete bipartite graphs.

Freitag, 13.11.1998 — Zeit: 17.30

36 — Sektion I — Raum PK 14.3 — 17.30

Asymptotic estimation on certain Product Ramsey Numbers

GEIR AGNARSSON
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We will derive an asymptotic upper bound for the Product Ramsey Number $PRN(m, k, r; t)$ in the case $k = 1$, r and t are arbitrary and where m is considered as a large number which tends to infinity. In simpler terms, we estimate how large R must be so that any r-coloring of the t-dimensional R-box will give a unicolor t-dimensional m-box. We do this by getting an upper bound for a function we know is actually larger than this Product Ramsey Number.

37 — Sektion II — Raum PK 14.4 — 17.30

Partial list colorings

MARGIT VOIGT
TU Ilmenau

Let G be a simple graph with vertex set V and edge set E and $L(v)$ a set (list) of allowed colors assigned to every vertex $v \in V(G)$. The collection of all lists $L(v)$ is called a list assignment and denoted by $\mathcal{L}$. For a list assignment $\mathcal{L}$, let $\lambda(\mathcal{L})$ be the maximum number of vertices that can be colored with respect to $\mathcal{L}$. Define $\lambda_t := \min \lambda(\mathcal{L})$ where the minimum is taken over all list assignments $\mathcal{L}$ satisfying $|L(v)| = t$ for all $v \in V$.

Albertson et.al. conjectured that $\lambda_t \geq \frac{tn}{\chi_\ell}$ for all $1 \leq t \leq \chi_\ell$ where n is the number of vertices and χ_ℓ is the list chromatic number of G. In the talk some results and algorithmic aspects concerning this conjecture will be discussed.

38 — Sektion III — Raum PK 14.6 — 17.30

The Graph of Linear Extensions of a Poset

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The graph $G(P)$ of linear extensions of a poset P has as vertices the linear extensions of P, and two of them are adjacent if they differ only by an adjacent transposition. It has so far been investigated mainly with respect to Hamilton paths and intrinsic geodesic convexity, and especially the work on the latter topic showed that the graph-theoretic properties of $G(P)$ reflect the order-theoretic structure of P in a very interesting way.

This talk presents new results on "classical" graph-theoretic properties of $G(P)$ (e.g. connectivity, cycle space) and their order-theoretic interpretation.

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39 — Sektion IV — Raum PK 14.7 — 17.30

Search for directed strongly regular graphs

LEIF K. JØRGENSEN
Aalborg University

Directed versions of strongly regular graphs can be defined in several ways: the number of either directed or antidirected paths of length two between a pair of vertices depends on the adjacency of the vertices. I am mainly interested in the case of antidirected paths. I this case some of the digraphs are association schemes. The topic of this talk will be the characterization of such digraphs with small parameters.

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40 — Sektion V — Raum PK 14.8 — 17.30

Intersection graphs of linear 3-uniform hypergraphs

ERICH PRISNER
Universität Hamburg, Germany

Intersection graphs of *linear* k-uniform hypergraphs are (one of several possible) natural generalizations of line graphs, but they are much more difficult to deal with, even for $k = 3$, on which we resitrict in what follows. For an integer d, let $\mathcal{P}(d)$ be the probl;em to decide whether any graph of minimum degree at least d is the intersection graph of some linear 3-uniform hypergraph. In 1982, R.N. NAIK, S.B. RAO, S.S. SHRIKHANDE, and N.M. SINGHI showed that $\mathcal{P}(69)$ can be solved in polynomial time. Last year, independently M.S. JACOBSON, A.E. KEZDY, J. LEHEL, as well as Y. METELSKY and R. TYSHKEVICH, improved that result and showed how to solve $\mathcal{P}(19)$ in polynomial time, but on the other hand, P. HLINENY and J. KRATOCHVIl essentially showed that $\mathcal{P}(6)$ is already NP-complete.

In this talk, I will show how to solve $\mathcal{P}(15)$ in polynomial time.

Freitag, 13.11.1998 — Zeit: 18.00

41 — Sektion I — Raum PK 14.3 — 18.00

On Multicolored Ramsey Numbers

ANNETTE SCHELTEN
TU Cottbus

By a k-coloring $(A_1, A_2, \ldots, A_k)$ we mean a coloring of the edges of a graph G with k different colors. All edges colored with color A_i induce the subgraph $< A_i >$ of G. The Ramsey Number $r(H_1, H_2, \ldots, H_k)$ of k Graphs is the minimum $p \in N$ such that for each k-coloring of K_p there is at least one subgraph $< A_i >$ which contains a graph isomorphic to H_i.

Together with Ralph Faudree and Ingo Schiermeyer we considered cases where $k = 3$ and the graphs G_i are all cycles of the same length.

42 — Sektion II — Raum PK 14.4 — 18.00

Permutation groups and coloured graphs

ULRIKE BAUMANN
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Since R. Frucht's result on representing abstract groups as automorphism groups of finite graphs, relations between groups and graphs have been studied intensively. We consider the problem of representing permutation groups by graphs with 1-factorizations. The problem is solved for permutation groups with an even number of orbits. If the number of orbits is odd, then partial results are obtained. Moreover, a relation to problems on Cayley graphs is stated.

43 — Sektion III — Raum PK 14.6 — 18.00

The evolution of partially ordered sets

ANUSCH TARAZ
Humboldt–Universität zu Berlin

The theme of this talk is the evolution process of partially ordered sets. We give a complete description of the evolution, prove that infinitely many phase transitions occur and determine the number of partially ordered sets with a given number of comparable pairs. This answers questions posed by Dhar, Kleitman, and Rothschild 20 years ago.

(Joint work with H.J. Prömel and A. Steger.)

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44 — Sektion IV — Raum PK 14.7 — 18.00

Hypothetical Complexity of the Nowhere-Zero 5-Flow Problem

MARTIN KOCHOL
Mathematical Institute, Slovak Academy of Sciences, Štefánikova 49, 814 73 Bratislava, Slovakia

A graph admits a *nowhere-zero k-flow* (k is an integer ≥ 2) if its edges can be oriented and labeled by numbers $\pm 1, \ldots, \pm(k-1)$ so that for every vertex, the sum of the incoming values equals the sum of the outcoming ones. The 5-*Flow Conjecture* of Tutte suggests that every bridgeless graph admits a nowhere-zero 5-flow. We show that if the 5-Flow Conjecture is not true, then the problem to determine whether a (cubic) graph admits a nowhere-zero 5-flow is NP-complete.

We can prove a similar hypothetical result for another well-know 3-*Flow Conjecture* of Tutte, which says that every 4-edge-connected graph has a nowhere-zero 3-flow. More precisely, we show that if there exists a 4-edge-connected graph without nowhere-zero 3-flow, then it is an NP-complete problem to determine whether a 4-edge-connected graph admits a nowhere-zero 3-flow.

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45 — Sektion V — Raum PK 14.8 — 18.00

Some Geometric Problems concerning Algebraic Linear Programming

HANS-HELMUT SCHEEL

Given a totally ordered commutative group G which admits (real) multipliers, one can formulate Algebraic Linear Programs

$$\begin{array}{l}\min c^T x\\ \text{s.t.}\\ Ax = b\end{array}$$

with (real) matrix A, (real) objective vector c and a right-hand side b consisting of elements of G. Therefore the variables x have to be elements of G, too.

A lot of results on Algebraic Linear Programming, even formulated in a more generally manner, are due to Burkard, Hoffman and Zimmermann.

In this talk we want to consider geometric aspects of ALP, especially convexity and the existence of a Helly number in n-dimensional G-space.

Sonnabend, 14.11.1998 — Zeit: 13.00

46 — Sektion I — Raum PK 14.3 — 13.00

Recent results on cyclic chromatic number of 3-connected planar graphs

STANISLAV JENDROL'
TU Ilmenau

We consider 3-connected plane graphs. By $\Delta^*(G)$ we denote the maximum face degree of G. A *cyclic colouring* of a plane graph G is such a colouring of the vertices of G that if two vertices are incident with a common face they receive different colours. Let a *k-colouring* of a graph G be a colouring of G using k colours. The *cyclic chromatic numbers* of a graph G, denoted by $\chi_c(G)$, is the minimum k such that G has a cyclic k-colourings. Obviously $\Delta^*(G) \leq \chi_c(G)$. Plummer and Toft have conjectured that $\chi_c(G) \leq \Delta^*(G) + 2$. Our lecture is devoted by a recent progress concerning the conjecture. Our main results are

Theorem 1. *(M. Horňák, S. Jendrol') Let G be a 3-connected plane graph with $\Delta^*(G) \geq 24$. Then $\chi_c(G) \leq \Delta^*(G) + 2$.*

Theorem 2. *(H. Enomoto, M. Horňák, S. Jendrol') Let G be a 3-connected plane graph with $\Delta^*(G) \geq 60$. Then $\chi_c(G) \leq \Delta^*(G) + 1$.*

47 — Sektion II — Raum PK 14.4 — 13.00

4-dimensional fullerenes

MICHEL DEZA
Dept. Math. et Info., Ecole Normale Sup. Paris

We explore the existence of high-dimensional analogues of fullerenes F_n (i.e. of simple polyhedra with only 5- and 6-gonal faces) seen as $(d-1)$-dimensional simple manifolds (preferably, polytopal or at least spherical) with only 5- and 6-gonal 2-faces. Three infinite families of such 4-fullerenes are presented here. The Construction A gives 4-polytopes by suitable insertion of fullerenes $F_{30}(D_{5h})$ into glued 120-cells. The Construction B gives 3-spheres by growing dodecahedra and barrels F_{24} around of given fullerene. The Construction C gives 4-fullerenes from special decoration of given 4-fullerene, which add fullerenes F_{20}, F_{24}, F_{26} and $F_{28}(T_d)$ only. Finally, infinite 5-fullerenes (including a simply connected $S^3 \times R^1$) are obtained (by a variation of gluing of two regular tilings 5333 of hyperbolic 4-space).

48 — Sektion III — Raum PK 14.6 — 13.00

Das Steinerverhältnis von Graphen

DIETMAR CIESLIK
Institut für Mathematik und Informatik, Universität Greifswald

Jeder Graph $G = (V, E)$ ist ein metrischer Raum (V, ρ), wenn $\rho(v, v')$ die Länge eines kürzesten Weges vom Knoten v zum Knoten v' in G darstellt. Sei N eine Menge von Knoten, dann ist ein Steiner Minimal Tree (SMT) für N ein kürzester N verbindender Teilbaum von G. Ihn zu finden ist algorithmisch von hoher Komplexität; genauer: es ist $\mathcal{NP}$-vollständig. Andererseits ist die Bestimmung eines Minimal Spanning Tree (MST) für N ein einfaches Problem. Somit ist ein MST eine Approximation eines SMT und das Steinerverhältnis

$$m(G) := \min\left\{\frac{\text{Länge eines SMT für } N}{\text{Länge eines MST für } N} : N \subseteq V\right\}$$

stellt eine Fehlerschranke dar.

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49 — Sektion IV — Raum PK 14.7 — 13.00

On the density of sets containing no three distinct numbers with all their sums

TOMASZ SCHOEN
Mathematisches Seminar, Universität zu Kiel

Let $\bar{d}(A) = \limsup_{n\to\infty} |A \cap \{1, \ldots, n\}|/n$ denote the upper density of a set A of positive integers.

Consider the following problem: find the maximal upper density of a set $A \subseteq N$ that contains no k distinct numbers $x_1, \ldots, x_k$ such that $x_{i_1} + \cdots + x_{i_j} \in A$ for every $1 \leq i_1 < \cdots < i_j \leq k$. This problem is trivial for $k = 2$. Obviously a set A with $\bar{d}(A) > 1/2$ contains distinct elements $a, b \in A$ with $a + b \in A$ and the set of odd numbers shows that the constant $1/2$ can be not replaced by a smaller one.

We solve the first nontrivial case $k = 3$, showing that the maximal upper density of a subset A of the natural numbers with no three distinct elements $a, b, c \in A$ such that $a + b, a + c, b + c, a + b + c \in A$ is equal to $2/3$.

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50 — Sektion V — Raum PK 14.8 — 13.00

The Spider poset is Macaulay

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Let $Q(k, l)$ be a poset whose Hasse diagram is a regular spider with $k+1$ legs having the same length l. We show that for any $n \geq 1$ the n^{th} cartesian power of the spider poset $Q(k, l)$ is a Macaulay poset for any $k \geq 0$ and $l \geq 1$. In combination with our recent results this provides a complete characterization of all Macaulay posets which are cartesian powers of upper semilattices, whose Hasse diagrams are trees.

Sonnabend, 14.11.1998 — Zeit: 13.30

51 — Sektion I — Raum PK 14.3 — 13.30

Labeled $K_{2,t}$-minors in plane graphs

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This is joint work with BOJAN MOHAR (Ljubljana Slovenia).

Let G be a 3-connected planar graph and let $U \subseteq V(G)$. It is shown that G contains a $K_{2,t}$-minor such that t is large and each vertex of degree 2 in $K_{2,t}$ corresponds to some vertex of U if and only if there is no small face cover of U. This result cannot be extended to 2-connected planar graphs.

52 — Sektion II — Raum PK 14.4 — 13.30

On the Non-Existence of Generalized Hadamard Matrices

GERHARD WESP
Universität Salzburg

Rank 2 chirotopes can be viewed as skew-symmetric matrices $\chi \in 1, 0, -1^{E \times E}$. Using a recent result of Knuth, we obtain a characterization of the chirotopes among such matrices via spectral properties. This characterization turns out to be especially simple in the uniform case, which we use to construct an inverse chirotope of χ in case E has an even number of elements. Applications of the results of this paper include a characterization of so-called unimodular orientations of the complete graph on vertex set E and of tournament graphs realizable in a certain sense.

53 — Sektion III — Raum PK 14.6 — 13.30

Isometric subgraphs of hypercubes

WILFRIED IMRICH
Montanuniversität Leoben

Partial cubes (isometric subgraphs of hypercubes), median graphs (retracts of hypercubes), semi-median graphs (a recently introduced class of graphs that lie strictly between partial cubes and median graphs) and related classes of graphs have recently received considerable attention in the literature. In this talk we shall briefly indicate where these graphs are used or occur and present efficient recognition algorithms based on structural properties of these classes.

In the case of median graphs a connection with triangle-free graphs allows to further improve the recognition complexity. This connection also illustrates that median graphs constitute a rather rich class of graphs and that the present recognition algorithms are most likely close to optimal.

With appropriate modifications these methods are also applicable to recognizing isometric subgraphs of Hamming graphs (Cartesian products of complete graphs) and quasimediangraphs.

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54 — Sektion IV — Raum PK 14.7 — 13.30

Coherence of metrics on six points

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For many applications in which a finite set of data gives rise to a metric it can be important to understand the structure of the metric cone on that finite set, e.g. when a metric has to be represented as a decomposition into simpler metrics.

In 1992 Bandelt and Dress introduced the coherent decomposition of a finite metric space (X, d) as a tool for clarifying the structure of the metric cone on X, which is intimately related to the structure of the *associated polytope* $P(d) := \{f : X \to \mathbb{R} | f(x) + f(y) \geq d(x, y) \text{ for all } x, y \in X\}$. More precisely, a decomposition $d = d_1 + d_2$ is called coherent, if $P(d) = P(d_1) + P(d_2)$ holds. As a natural consequence of this definition we define prime metrics to be those metrics that cannot be coherently decomposed in a non-trivial way.

We developed and applied this theory to the metric cone on six points, and computed the complete set of six-point prime metrics (which, in general, we can also show to be finite in number for a fixed finite set – up to the usual concept of isomorphism of metrics). This will lead to a deeper understanding of the structure of this cone. It also highlighted some of the problems that will arise, when coherently decomposing metrics on larger sets.

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55 — Sektion V — Raum PK 14.8 — 13.30

Erweiterungen von C*-Algebren via Erzeugender und Relationen (Extensions of C*-algebras given by generators and relations)

EBERHARD H.-A. GERBRACHT
Institut für Netzwerktheorie und Schaltungstechnik, TU Braunschweig

Each tripel $(M, \mathcal{R}, \mu)$, consisting of a set M – the *generators* – a subset $\mathcal{R}$ of the free involutive algebra $\mathbb{C}^*\langle M\rangle$ generated by M – the *relations*.– and a mapping $\mu : M \to \mathbb{R}_+$, uniquely defines a universal C*-algebra $C^*\langle M, \mathcal{R}, \mu\rangle$.

In this talk we will be concerned with the question, how in certain cases, when given an extension

$$0 \longrightarrow A \xrightarrow{\iota} E \xrightarrow{\pi} B \longrightarrow 0;$$

of C*-algebras, where A and B are universal C*-algebras, which are defined by presentations $C^*\langle M, \mathcal{R}, \mu\rangle$ and $C^*\langle N, \mathcal{S}, \nu\rangle$, respectively, a presentation of the extension E might be constructed.

Sonnabend, 14.11.1998 — Zeit: 14.00

56 — Sektion I — Raum PK 14.3 — 14.00

Posets and Planar Graphs

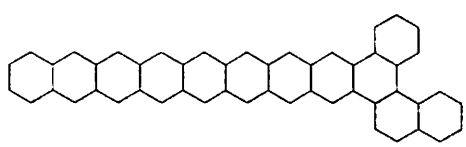
STEFAN FELSNER (FU-BERLIN)

In 1989, W. Schnyder proved that a graph is planar if and only if its dimension is at most 3. We introduce a fractional version of dimension and show that a graph is outerplanar if and only if its dimension is at most $5/2$. Extending recent work of Hoşten and Morris, we show that the largest n for which the dimension of the complete graph K_n is at most $t - \frac{1}{2}$ is the number of antichains in the lattice of all subsets of a set of size $t - 2$. For $t = 4$, we show that any graph for which the vertex set can be partitioned into 2 parts so that each part induces an outerplanar graph has dimension at most $7/2$, and we conjecture that this is a full characterization of such graphs. This research was stimulated by an extremal graph theory problem posed by Agnarsson: Find the maximum number of edges in a graph on n nodes with dimension at most t.

57 — Sektion II — Raum PK 14.4 — 14.00

Mathematics, Chemistry and Record Hunting

Gunnar Brinkmann [*], Gilles Caporossi [†], Pierre Hansen [‡]



The enumeration of special classes of molecules is an important topic in combinatorial chemistry. Enumerating the class of pairwise non isomorphic *benzenoid* isomers, that is, simply connected patches made of regular hexagons in the plane, became a standard benchmark problem and was attacked by several authors before. In this talk, we will present a new and easy algorithm to generate benzenoids and generalised benzenoids (where we do not require the patch of regular hexagons to fit into the plane without overlap) that is by several orders of magnitude faster than all previous methods. Inside the reach of the program, the generation rate (that is the number of non-isomorphic structures generated per second) even grows with the number of hexagons.

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58 — Sektion III — Raum PK 14.6 — 14.00

Construction Methods for Sparse Gossip Graphs

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A graph on an even number of vertices, n, is called a *gossip graph* iff it allows to perform gossiping (all-to-all broadcasting) under the bidirectional 1-port unit-cost model within the minimum number of time steps, $\lceil \log_2 n \rceil$. Among all of them, graphs having the minimum number of edges are called *minimum gossip graphs*. In general, it seems to be very hard to find such graphs, in particular, because we know this minimum number only for very few values of n. Hence, also graphs with few but possibly not the minimum number of edges, *sparse* gossip graphs, are of interest. In the talk, we show the known results on minimum gossip graphs, and explain different general ideas for constructing sparse gossip graphs. This includes direct constructions (hypercubes, Cayley graphs), as well as old and new recursive constructions (product, compound). Finally, we discuss the results obtained by these methods.

59 — Sektion IV — Raum PK 14.7 — 14.00

How to draw a hexagon

ANDREAS SCHROTH
Technische Universität Braunschweig

Es wird ein Modell einer der beiden kleinsten verallgemeinerten Sechsecke vorgestellt. Dieses Modell ist nicht nur ästhetisch ansprechend sondern illustriert auch deutlich einige Eigenschaften des Sechsecks. Zudem wird eine Konstruktionsmethode sichtbar, die auf verallgemeinerte Drei- und Vierecke angewendet ebenfalls schöne Modelle ergibt.

60 — Sektion V — Raum PK 14.8 — 14.00

Large h-Sidon sets in abelian groups

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Let G be a finite additive abelian group of order n, and let $h \in \mathbb{N}_{\geq 2}$. A subset $S \subseteq G$ is called h-Sidon set, if for every pair of subsets T, T' consisting of h elements if follows from $\sum_{t \in T} t = \sum_{t' \in T'} t'$ that $T = T'$. We are interested in lower bounds for the maximal size of h-Sidon sets. For 2-Sidon sets in $\mathbb{N}$ the problem has been solved by Erdös and Turan, who proved that the size is $\Theta(\sqrt{n})$. In 1962 Bose and Chowla showed that there exists an h-Sidon set of cardinality at least $\sqrt[h]{n} - \mathcal{O}(n^{\frac{2}{3}h})$ if G is cyclic. For the general case we prove via probabilistic arguments that $\mathcal{O}(n^{\frac{1}{2h-1}})$ is a lower bound and that $\tau : n \mapsto n^{\frac{1}{2h}}$ is a threshold function for the h-Sidon property. Recent work of Thiele sugggests that is should be possible to improve this bound to at least $\mathcal{O}((n \log n)^{\frac{1}{2h-1}})$. Finally we point out an interesting application of Sidon sets, the bounding of the size of subsets in $\mathbb{N}$ satisfying a subset sum property introduced by Erdös.

Sonnabend, 14.11.1998 — Zeit: 14.30

61 — Sektion I — Raum PK 14.3 — 14.30

Embedding two edge-disjoint Copies of a Tree in a complete bipartite Graph of the same Order

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The study of edge-disjoint embeddings of two or more graphs into certain other graphs led to some of the classical conjectures in graph theory. Apart from Gyáfrás' tree packing conjecture and Ringel's conjecture which deal with edge-disjoint embeddings of several trees into complete graphs, many authors studied edge-disjoint embeddings of few graphs of small size. A natural first question in this context, often considered over the last thirty years, asks for those graphs G of small size such that there is an edge-disjoint embedding of two copies of G into a complete or a complete bipartite graph of an order related to the order of G. In this talk we first survey some related results and then characterize all trees T such that the complete bipartite graph on the two partite sets of T (and hence of the same order as T) contains two edge-disjoint copies of T.

62 — Sektion II — Raum PK 14.4 — 14.30

Ein diskretes Analogon zum Begriff "rechtsseitiger Häufungspunkt"

E. HARZHEIM
Universität Düsseldorf

Es gilt folgender Satz

SATZ. Seien n, a, b, d natürliche Zahlen mit $n \geq a \geq b < d$, und sei A eine Menge von a natürlichen Zahlen des Intervalls $[1, n]$. Dann gibt es mindestens $a - b - d \cdot \frac{n-a}{d-b}$ Zahlen x in A, für die das offene Intervall $(x, x+d)$ mindestens b Zahlen von A enthält.

Diese Aussage ist scharf. (Die obigen Einschränkungen zu a, b, d schließen lediglich Trvialfälle aus.)

63 — Sektion III — Raum PK 14.6 — 14.30

Some new matroidal constructions on the edge set of graphs

ANDRÁS RECSKI
Technical University of Budapest

Let G be a 2-connected undirected graph with n vertices. Its connected subgraphs of $n-1$ edges (that is, its spanning trees) are the bases of the usual cycle matroid of G. Let now X be a subset of vertices of G and consider those connected subgraphs of n edges whose unique circuit passes through at least one vertex of X. They are shown to be the bases of another matroid. A similar construction is given if connectivity is not required but every circuit of the subgraph must pass through at least one vertex of X. Relation of the first construction to elementary strong maps (if G is planar) and representability properties of the matroids arising from the second construction are also presented. Finally a civil engineering problem is described which served as the original motivation of this study.

64 — Sektion IV — Raum PK 14.7 — 14.30

Weakly Flag-Transitive Configurations

TOMAŽ PISANSKI*
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A configuration is *weakly flag-transitive (WFT)* if its group of automorphisms acts intransitively on flags but the group of all automorphisms and anti-automorphisms acts transitively on flags. A WFT configuration is necessarily symmetric and self-dual. WFT configurations are in one-to-one correspondence with bipartite $\frac{1}{2}$-arc-transitive graphs of girth not less than 6. This implies that if an n_k configuration is WFT then k must be an even number. Infinite families of WFT configurations can be constructed via their $\frac{1}{2}$-arc-transitive Levi graphs. The smallest known WFT configuration on 27 points, non-self-polar WFT configuration on 34 points, and non-self-polar, triangle-free WFT configuration on 68 points are presented.

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65 — Sektion V — Raum PK 14.8 — 14.30

Factorization of polynomials over arbitrary finite fields

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Two algorithms for factoring polynomials are extended to finite fields. In particular I show that there exists a deter ministic algorithm which factors completely all monic polynomials of degree n over $GF(q)$ using $O(q^{1/2}n^{2+\epsilon}\log q)$ operations in $GF(q)$ in the worst case. The algorithm factors all except possibly $O((n\log q)^2/q)$ polynomials using $O(n^{2+\epsilon}(\log q)^2)$ operartions in $GF(q)$.

Sonnabend, 14.11.1998 — Zeit: 15.30

66 — Sektion I — Raum PK 14.3 — 15.30

On the life and combinatorial work of Levi and Steinitz

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This talk will discuss the two German (and Jewish) mathematicians F.W. Levi (1888-1966) and E. Steinitz (1871-1928) and their work on configurations. It is related to the author's poster which was presented in Berlin (ICM, August 1998). Configurations are linear regular uniform hypergraphs, defined in 1876 by Th. Reye.

The contributions of Steinitz (mainly his dissertation and his encyclopedia paper) and of Levi (mainly his book on configurations) will be shortly described. The notion of the Levi graph of a configuration will be (re)introduced as well as the results of Steinitz on 1-factors in regular bipartite graphs and on nearly linear drawings of configurations will be presented.

Moreover, related to the political situation in 20^{th} Germany, the private lives of Levi and Steinitz (and their families) will be described which will lead us (unfortunately) as far as India and Israel.

67 — Sektion II — Raum PK 14.4 — 15.30

Discrete methods in Algebraic Topology

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In this survey we analyze the discrete nature of some methods in Algebraic Topology in order to show the computability problems they carry with. We move in the setting of Simplicial or Combinatorial Topology [*Simplicial objects in Algebraic Topology*, P. May, Princeton: Van Nostrand, 1967]. We deal with two problems:

1. To obtain general combinatorial formulae for the action of Steenrod operations on the cohomology of any simplicial set. A solution for Steenrod squares has already been explained in [*Combinatorial method for computing Steenrod squares*, R. González-Díaz and P. Real, To appear in J. of Pure and Applied Algebra]. The general case is still open.

2. Let $\Omega(X)$ denote the loop space of a simplicial set X and $C_*(K)$ be the chain complex canonically associated to a simplicial set K. The second question consists in establishing the generators of the coalgebra $C_*(\Omega(X))$.

68 — Sektion III — Raum PK 14.6 — 15.30

Generating 3-regular maps with given face sizes

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The problem to be solved is the generation of 3-regular polyhedra with given face sizes. It can be formulated for the dual as well: generating triangulations, where the set of allowed degrees is restricted.

There already is an efficient algorithm for generating all 3-regular polyhedra and another one for the generation of 3-regular polyhedra with a restricted sequence of face sizes which is fast in some cases, but not in general.

We will present a method to restrict the algorithm for generating all 3-regular polyhedra to construct only those with certain allowed degrees. This approach is especially efficient for those cases where not too much possible face sizes are forbidden.

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69 — Sektion IV — Raum PK 14.7 — 15.30

On the Non-Existence of Generalized Hadamard Matrices

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It is shown that the solvability of certain norm forms is necessary for the existence of some generalized Hadamard matrices. The number-theoretic consequences of this are explored.

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70 — Sektion V — Raum PK 14.8 — 15.30

Sperner Properties of Random Subsets of a Finite Set

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A classical lemma of Sperner asserts that a maximum antichain of the power set $\mathcal{P}(n)$ of a finite set $[n] = \{1, \ldots, n\}$ may be obtained by picking all those subsets of $\mathcal{P}(n)$ which have cardinality $\lfloor n/2 \rfloor$. We prove that a similar phenomenon occurs when one considers random subsets of $\mathcal{P}(n)$. Such a random subset $\mathcal{P}(n,p)$ is obtained by selecting each element of $\mathcal{P}(n)$ with probability p independently of all other elements. This model was first considered by Rényi, who, answering a question of Erdős, determined the threshold for the property that $\mathcal{P}(n,p)$ is not an antichain itself. Our results are obtained by a double counting argument applied to chains in $\mathcal{P}(n,p)$, following the elegant proof of Sperner's Lemma by Lubell.

Sonnabend, 14.11.1998 — Zeit: 16.00

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71 — Sektion I — Raum PK 14.3 — 16.00

Root Images of Median Filters

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Median filters are nonlinear discrete filters. One important question in analyzing nonlinear filters is the set of those signals which remain unchanged under application of the filter. These *root images* constitute an analog of the passband for linear filters.

In 1989, Doehler published a result on certain root images for two–dimensional median filters. However, one can find counterexamples indicating that this result cannot be true as stated by Doehler. Moreover, Doehlers results are restricted to very special situations.

Using concepts from digital geometry, we show that under a suitable normality condition imposed on the filter the set of all *digitally convex* root images of the d–dimensional *digital space* generated by the filter window can be characterized.

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72 — Sektion II — Raum PK 14.4 — 16.00

Lineare homogene partielle Differenzengleichungen

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Gegeben sei eine Zahlentabelle $u(n,k)$, die eine lineare homogene partielle Differenzengleichung mit Polynomkoeffizienten erfüllt. Die Stirlingschen Zahlen 2. Art z. B. erfüllen die Gleichung

$$S(n,k) = S(n-1,k-1) + k\,S(n-1,k) \qquad (n,k \geq 1)\ .$$

Ich berechne aus der partiellen Differenzengleichung und den gewöhnlichen Differenzengleichungen für die Anfangsdaten eine gewöhnliche Differenzengleichung für die n-te Zeile $u(n,\cdot)$ von u.

73 — Sektion III — Raum PK 14.6 — 16.00

On perfect codes and related concepts

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The concept of D–perfect codes, which seems to be a natural generalization of e–perfect codes (codes attaining the sphere–packing bound) is introduced. This was motivated by the "code–anticode" bound of Delsarte in distance regular graphs. This bound in conjunction with the recent complete solutions of diametric problems in the Hamming graph $\mathcal{H}_q(n)$ and the Johnson graph $J(n,k)$ gives a sharpening of the sphere–packing bound. Some necessary conditions for the existence of D–perfect codes are given. In the Hamming graph all D–perfect codes over alphabets of prime power size are characterized. The problem of tiling of the vertex set of $J(n,k)$ with caps (and maximal anticodes) is also examined.

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74 — Sektion IV — Raum PK 14.7 — 16.00

Linear and Hereditary Discrepancy

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Let A be a $m \times n$–matrix. Linear and hereditary discrepancy are defined as

$$\begin{aligned} \operatorname{lindisc}(A) &:= \max\{\min\{\|A(p-\varepsilon)\|_\infty \mid \varepsilon \in \{-1,1\}^n\} \mid p \in [-1,1]^n\} \\ \operatorname{herdisc}(A) &:= \max\{\min\{\|(a_{ij})_{i\in[m],j\in J}\,\varepsilon\|_\infty \mid \varepsilon \in \{-1,1\}^n\} \mid J \subseteq [n]\}. \end{aligned}$$

We're investigating connections between the two concepts. Best results known are
$\operatorname{lindisc}(A) \le 2(1-2^{-2^n})\operatorname{herdisc}(A)$ for any matrix A and an example of an A satisfying
$\operatorname{lindisc}(A) = 2(1-\frac{1}{n+1})\operatorname{herdisc}(A)$. We show

$$\operatorname{lindisc}(A) \le 2\left(1-2^{-\lfloor \log_2(m)\rfloor -1}\right)\operatorname{herdisc}(A) \quad \left(\le 2\left(1-\tfrac{1}{2m}\right)\operatorname{herdisc}(A)\right).$$

Unless $m \ge 2^{2^n-1}$, this is better than the known results. We provide an example showing that our bound is almost the best possible (in terms of m).

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75 — Sektion V — Raum PK 14.8 — 16.00

Ueber volle partielle Quasigruppen endlicher Ordnung

J. QUISTORFF, HAMBURG

Stojakovic/Usan schaetzen die minimale Groesse einer vollen partiellen Quasigruppe endlicher Ordnung nach unten ab. Dieses Ergebnis kann erheblich verbessert und auf den Fall voller partieller n-Quasigruppen verallgemeinert werden: Es werden eine implizite untere sowie einige obere Schranken praesentiert. Hierdurch kann die minimale Groesse einer vollen partiellen Quasigruppe jeder endlichen Ordnung bestimmt werden. Entsprechendes gelingt bei manchen Parameterkonstellationen auch fuer volle partielle n-Quasigruppen. Stellenweise wird dabei auf Ergebnisse der Codierungstheorie zurueckgegriffen.

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