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The editors of DMTCS

Discrete Mathematics and Theoretical Computer Science (DMTCS), Nancy, France

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As you will see from this document, not all abstracts for the proceedings volumes have yet been reworked to provide valid LaTeX. We apologize for any incovenience that this may cause.

Journal's ISSN: 1365–8050

[DMTCS-010101] Csaba Schneider. Computing nilpotent quotients in finitely presented Lie rings. *Discrete Mathematics and Theoretical Computer Science*, 1(1):1–16, 1997.

http://www.dmtcs.org/volumes/abstracts/dm010101.abs.html

A nilpotent quotient algorithm for finitely presented Lie rings over **Z** (and **Q**) is described. The paper studies the graded and non-graded cases separately. The algorithm computes the so-called nilpotent presentation for a finitely presented, nilpotent Lie ring. A nilpotent presentation consists of generators for the abelian group and the products expressed as linear combinations for pairs formed by generators. Using that presentation the word problem is decidable in L. Provided that the Lie ring L is graded, it is possible to determine the canonical presentation for a lower central factor of L. Complexity is studied and it is shown that optimising the presentation is NP-hard. Computational details are provided with examples, timing and some structure theorems obtained from computations. Implementation in C and GAP interface are available.

[DMTCS-010102] V. Giakoumakis, F. Roussel, and H. Thuillier. On P_4-tidy graphs. *Discrete Mathematics and Theoretical Computer Science*, 1(1):17–41, 1997.

http://www.dmtcs.org/volumes/abstracts/dm010102.abs.html

We study the P_4-tidy graphs, a new class defined by Rusu [30] in order to illustrate the notion of P_4-domination in perfect graphs. This class strictly contains the P_4-extendible graphs and the P_4-lite graphs defined by Jamison & Olariu in [19] and [23] and we show that the P_4-tidy graphs and P_4-lite graphs are closely related. Note that the class of P_4-lite graphs is a class of brittle graphs strictly containing the P_4-sparse graphs defined by Hoang in [14]. McConnel & Spinrad [2] and independently Cournier & Habib [5] have shown that the modular decomposition tree of any graph is computable in linear time. For recognizing in linear time P_4-tidy graphs, we apply a method introduced by Giakoumakis in [9] and Giakoumakis & Fouquet in [6] using modular decomposition of graphs and we propose linear algorithms for optimization problems on such graphs, as clique number, stability number, chromatic number and scattering number. We show that the Hamiltonian Path Problem is linear for this class of graphs. Our study unifies and generalizes previous results of Jamison & Olariu ([18], [21], [22]), Hochstattler & Schindler[16], Jung [25] and Hochstattler & Tinhofer [15].

[DMTCS-010103] Augustin Ido and Guy Melançon. Lyndon factorization of the Thue-Morse word and its relatives. *Discrete Mathematics and Theoretical Computer Science*, 1(1):43–52, 1997.

http://www.dmtcs.org/volumes/abstracts/dm010103.abs.html

We compute the Lyndon factorization of the Thue-Morse word. We also compute the Lyndon factorization of two related sequences involving morphisms that give rise to new presentations of these sequences.

[DMTCS-010104] Jean-Christophe Novelli, Igor Pak, and Alexander V. Stoyanovskii. A direct bijective proof of the hook-length formula. *Discrete Mathematics and Theoretical Computer Science*, 1(1):53–67, 1997.

http://www.dmtcs.org/volumes/abstracts/dm010104.abs.html

This paper presents a new proof of the hook-length formula, which computes the number of standard Young tableaux of a given shape. After recalling the basic definitions, we present two inverse algorithms giving the desired bijection. The next part of the paper presents the proof of the bijectivity of our construction. The paper concludes with some examples.

[DMTCS-010105] Sébastien Limet and Pierre Réty. E-unification by means of tree tuple synchronized grammars. *Discrete Mathematics and Theoretical Computer Science*, 1(1):69–98, 1997.

http://www.dmtcs.org/volumes/abstracts/dm010105.abs.html

The goal of this paper is both to give an E-unification procedure that always terminates, and to decide unifiability. For this, we assume that the equational theory is specified by a confluent and constructor-based rewrite system, and that four additional restrictions are satisfied. We give a procedure that represents the (possibly infinite) set of solutions thanks to a tree tuple synchronized grammar, and that can decide upon unifiability thanks to an emptiness test. Moreover, we show that if only three of the four additional restrictions are satisfied then unifiability is undecidable.

[DMTCS-010106] Gérard Jacob and Pierre-Vincent Koseleff (guest editors). Special issue: 'Lie Computations'. *Discrete Mathematics and Theoretical Computer Science*, 1(1):99–100, 1997.

http://www.dmtcs.org/volumes/abstracts/dm010106.abs.html

This special issue is an outgrowth of the MEDICIS thematic workshop on Lie Computations that was held at the Centre International de Rencontres Mathématiques in Marseilles in November 1994. It was jointly sponsored by the Groupe de Recherche MEDICIS, the CIRM (Société Mathématique de France), and the European project INTAS 93-30.

[DMTCS-010107] Philippe Andary. Finely homogeneous computations in free Lie algebras. *Discrete Mathematics and Theoretical Computer Science*, 1(1):101–114, 1997.

http://www.dmtcs.org/volumes/abstracts/dm010107.abs.html

We first give a fast algorithm to compute the maximal Lyndon word (with respect to lexicographic order) of $Ly_\alpha(A)$ for every given multidegree alpha in $\mathbf{N}^k$. We then give an algorithm to compute all the words living in $Ly_\alpha(A)$ for any given α in $\mathbf{N}^k$. The best known method for generating Lyndon words is that of Duval [1], which gives a way to go from every Lyndon word of length n to its successor (with respect to lexicographic order by length), in space and worst case time complexity $O(n)$. Finally, we give a simple algorithm which uses Duval's method (the one above) to compute the next standard bracketing of a Lyndon word for lexicographic order by length. We can find an interesting application of this algorithm in control theory, where one wants to compute within the command Lie algebra of a dynamical system (letters are actually vector fields).

[DMTCS-010108] H. Caprasse. BRST charge and Poisson algebras. *Discrete Mathematics and Theoretical Computer Science*, 1(1):115–127, 1997.

http://www.dmtcs.org/volumes/abstracts/dm010108.abs.html

An elementary introduction to the classical version of gauge theories is made. The shortcomings of the usual gauge fixing process are pointed out. They justify the need to replace it by a global symmetry: the BRST symmetry and its associated BRST charge. The main mathematical steps required to construct it are described. The algebra of constraints is, in general, a nonlinear Poisson algebra. In the nonlinear case the computation of the BRST charge by hand is hard. Itis explained how this computation can be made algorithmic. The main features of a recently created BRST computer algebra program are described. It can handle quadratic algebras very easily. Its capability to compute the BRST charge as a formal power series in the generic case of a cubic algebra is illustrated.

[DMTCS-010109] A. M. Cohen, W. A. de Graaf, and L. Rónyai. Computations in finite-dimensional Lie algebras. *Discrete Mathematics and Theoretical Computer Science*, 1(1):129–138, 1997.

http://www.dmtcs.org/volumes/abstracts/dm010109.abs.html

This paper describes progress made in context with the construction of a general library of Lie algebra algorithms, called ELIAS (Eindhoven Lie Algebra System), within the computer algebra package GAP. A first sketch of the package can be found in Cohen and de Graaf[1]. Since then, in a collaborative effort with G. Ivanyos, the authors have continued to develop algorithms which were implemented in ELIAS by the second author. These activities are part of a bigger project, called ACELA and financed by STW, the Dutch Technology Foundation, which aims at an interactive book on Lie algebras (cf. Cohen and Meertens [2]). This paper gives a global description of the main ways in which to present Lie algebras on a computer. We focus on the transition from a Lie algebra abstractly given by an array of structure constants to a Lie algebra presented as a subalgebra of the Lie algebra of $n \times n$ matrices. We describe an algorithm typical of the structure analysis of a finite-dimensional Lie algebra: finding a Levi subalgebra of a Lie algebra.

[DMTCS-010110] S. Cojocaru and V. Ufnarovski. BERGMAN under MS-DOS and Anick's resolution. *Discrete Mathematics and Theoretical Computer Science*, 1(1):139–147, 1997.

http://www.dmtcs.org/volumes/abstracts/dm010110.abs.html

Noncommutative algebras, defined by the generators and relations, are considered. The definition and main results connected with the Gröbner basis, Hilbert series and Anick's resolution are formulated. Most attention is paid to universal enveloping algebras. Four main examples illustrate the main concepts and ideas. Algorithmic problems arising in the calculation of the Hilbert series are investigated. The existence of finite state automata, defining thebehaviour of the Hilbert series, is discussed. The extensions of the BERGMAN package for IBM PC compatible computers are described. A table is provided permitting a comparison of the effectiveness of the calculations in BERGMAN with the other systems.

[DMTCS-010111] Alex J. Dragt. A Lie connection between Hamiltonian and Lagrangian optics. *Discrete Mathematics and Theoretical Computer Science*, 1(1):149–157, 1997.

http://www.dmtcs.org/volumes/abstracts/dm010111.abs.html

It is shown that there is a non-Hamiltonian vector field that provides a Lie algebraic connection between Hamiltonian and Lagrangian optics. With the aid of this connection, geometrical optics can be formulated in such a way that all aberrations are attributed to ray transformations occurring only at lens surfaces. That is, in this formulation there are no aberrations arising from simple transit in a uniform medium. The price to be paid for this formulation is that the Lie algebra of Hamiltonian vector fields must be enlarged to include certain non-Hamiltonian vector fields. It is shown that three such vector fields are required at the level of third-order aberrations, and sufficient machinery is developed to generalize these results to higher order.

[DMTCS-010112] Gérard Duchamp, Alexander Klyachko, Daniel Krob, and Jean-Yves Thibon. Noncommutative symmetric functions III: Deformations of Cauchy and convolution algebras. *Discrete Mathematics and Theoretical Computer Science*, 1(1):159–216, 1997.

http://www.dmtcs.org/volumes/abstracts/dm010112.abs.html

This paper discusses various deformations of free associative algebras and of their convolution algebras. Our main examples are deformations of noncommutative symmetric functions related to families of idempotents in descent algebras, and a simple q-analogue of the shuffle product, which has unexpected connections with quantum groups, hyperplane arrangements, and certain questions in mathematical physics (the quon algebra, generalized Brownian motion).

[DMTCS-010113] Vladimir P. Gerdt and Vladimir V. Kornyak. An algorithm for analysis of the structure of finitely presented Lie algebras. *Discrete Mathematics and Theoretical Computer Science*, 1(1):217–228, 1997.

http://www.dmtcs.org/volumes/abstracts/dm010113.abs.html

We consider the following problem: what is the most general Lie algebra satisfying a given set of Lie polynomial equations? The presentation of Lie algebras by a finite set of generators and defining relations is one of the most general mathematical and algorithmic schemes of their analysis. That problem is of great practical importance, covering applications ranging from mathematical physics to combinatorial algebra. Some particular applications are constructionof prolongation algebras in the Wahlquist-Estabrook method for integrability analysis of nonlinear partial differential equations and investigation of Lie algebras arising in different physical models. The finite presentations also indicate a way to q-quantize Lie algebras. To solve this problem, one should perform a large volume of algebraic transformations which is sharply increased with growth of the number of generators and relations. For this reason, in practice one needs to use a computer algebra tool. We describe here an algorithm for constructing the basis of a finitely presented Lie algebra and its commutator table, and its implementation in the C language. Some computer results illustrating our algorithmand its actual implementation are also presented.

[DMTCS-010114] Maurice Ginocchio. On the bialgebra of functional graphs and differential algebras. *Discrete Mathematics and Theoretical Computer Science*, 1(1):229–237, 1997.

http://www.dmtcs.org/volumes/abstracts/dm010114.abs.html

We develop the bialgebraic structure based on the set of functional graphs, which generalize the case of the forests of rooted trees. We use noncommutative polynomials as generating monomials of the functional graphs, and we introduce circular and arborescent brackets in accordance with the decomposition in connected components of the graph of a mapping of $\{1, 2, \ldots, n\}$ in itself as in the frame of the discrete dynamical systems. We give applications fordifferential algebras and algebras of differential operators.

[DMTCS-010115] Yuri L. Sachkov. Controllability of affine right-invariant systems on solvable Lie groups. *Discrete Mathematics and Theoretical Computer Science*, 1(1):239–246, 1997.

http://www.dmtcs.org/volumes/abstracts/dm010115.abs.html

The aim of this paper is to present some recent results on controllability of right-invariant systems on Lie groups. From the Lie-theoretical point of view, we study conditions under which subsemigroups generated by half-planes in the Lie algebra of a Lie group coincide with the whole Lie group.

[DMTCS-010116] Alois Panholzer and Helmut Prodinger. Descendants and ascendants in binary trees. *Discrete Mathematics and Theoretical Computer Science*, 1(1):247–266, 1997.

http://www.dmtcs.org/volumes/abstracts/dm010116.abs.html

There are three classical algorithms to visit all the nodes of a binary tree - preorder, inorder and postorder traversal. From this one gets a natural labelling of the n internal nodes of a binary tree by the numbers $1, 2, ..., n$, indicating the sequence in which the nodes are visited. For given n (size of the tree) and j (a number between 1 and n), we consider the statistics number of ascendants of node j and number of descendants of node j. By appropriate trivariate generating functions, we are able to find explicit formulae for the expectation and the variance in all instances. The heavy computations that are necessary are facilitated by MAPLE and Zeilberger's algorithm. A similar problem comes fromlabelling the leaves from left to right by $1, 2, ..., n$ and considering the statistic number of ascendants (=height) of leaf j. For this, Kirschenhofer [1] has computed the average. With our approach, we are also able to get the variance. In the last section, a table with asymptotic equivalents is provided for the reader's convenience.

[DMTCS-020101] Christopher Lynch and Polina Strogova. SOUR graphs for efficient completion. *Discrete Mathematics and Theoretical Computer Science*, 2(1):1–25, 1998.

http://www.dmtcs.org/volumes/abstracts/dm020101.abs.html

We introduce a data structure called *SOUR* graphs and present an efficient Knuth-Bendix completion procedure based on it. *SOUR* graphs allow for a maximal structure sharing of terms in rewriting systems. The term representation is a dag representation, except that edges are labelled with equational constraints and variable renamings. The rewrite rules correspond to rewrite edges, the unification problems to unification edges. The Critical Pair and Simplification inferences are recognized as patterns in the graph and are performed as local graph transformations. Our algorithm avoids duplicating term structure while performing inferences, which causes exponential behavior in the standard procedure. This approach gives a basis to design other completion algorithms, such as goal-oriented completion, concurrent completion and group completion procedures.

[DMTCS-020102] Philippe Duchon. Right-cancellability of a family of operations on binary trees. *Discrete Mathematics and Theoretical Computer Science*, 2(1):27–33, 1998.

http://www.dmtcs.org/volumes/abstracts/dm020102.abs.html

We prove some new results on a family of operations on binary trees, some of which are similar to addition, multiplication and exponentiation for natural numbers. The main result is that each operation in the family is right-cancellable.

[DMTCS-020103] Giovanni Manzini. Lower bounds for sparse matrix vector multiplication on hypercubic networks. *Discrete Mathematics and Theoretical Computer Science*, 2(1):35–47, 1998.

http://www.dmtcs.org/volumes/abstracts/dm020103.abs.html

In this paper we consider the problem of computing on a local memory machine the product $y = Ax$,where A is a random $n \times n$ sparse matrix with $\Theta(n)$ nonzero elements. To study the average case communication cost of this problem, we introduce four different probability measures on the set of sparse matrices. We prove that on most local memory machines with p processors, this computation requires $\Omega((n/p)\log p)$ time on the average. We prove that the same lower bound also holds, in the worst case, for matrices with only $2n$ or $3n$ nonzero elements.

[DMTCS-020104] I. Dutour and J.M. Fedou. Object grammars and random generation. *Discrete Mathematics and Theoretical Computer Science*, 2(1):49–63, 1998.

http://www.dmtcs.org/volumes/abstracts/dm020104.abs.html

This paper presents a new systematic approach for the uniform random generation of combinatorial objects. The method is based on the notion of object grammars which give recursive descriptions of objects and generalize context-freegrammars. The application of particular valuations to these grammars leads to enumeration and random generation of objects according to non algebraic parameters.

[DMTCS-030101] Ulrik Brandes and Dagmar Handke. *NP*-completeness results for minimum planar spanners. *Discrete Mathematics and Theoretical Computer Science*, 3(1):1–10, 1998.

http://www.dmtcs.org/volumes/abstracts/dm030101.abs.html

For any fixed parameter t greater or equal to 1, a *t-spanner* of a graph G is a spanning subgraph in which the distance between every pair of vertices is at most t times their distance in G. A *minimum* t-spanner is a t-spanner with minimum total edge weight or, in unweighted graphs, minimum number of edges. In this paper, we prove the NP-hardness of finding minimum t-spanners for planar weighted graphs and digraphs if t greater or equal to 3, and for planar unweighted graphs and digraphs if t greater or equal to 5. We thus extend results on that problem to the interesting case where the instances are known to be planar. We also introduce the related problem of finding minimum *planar* t-spanners and establish its NP-hardness for similar fixed values of t.

[DMTCS-030102] Christian Krattenthaler. An involution principle-free bijective proof of Stanley's hook-content formula. *Discrete Mathematics and Theoretical Computer Science*, 3(1):11–32, 1998.

http://www.dmtcs.org/volumes/abstracts/dm030102.abs.html

A bijective proof for Stanley's hook-content formula for the generating function for column-strict reverse plane partitions of a given shape is given that does not involve the involution principle of Garsia and Milne. It is based on the Hillman-Grassl algorithm and Schützenberger's *jeu de taquin*.

[DMTCS-030201] Elisha Falbel and Pierre-Vincent Koseleff. The number of sides of a parallelogram. *Discrete Mathematics and Theoretical Computer Science*, 3(2):33–42, 1999.

http://www.dmtcs.org/volumes/abstracts/dm030201.abs.html

We define parallelograms of base a and b in a group. They appear as minimal relators in a presentation of a subgroup with generators a and b. In a Lie group they are realized as closed polygonal lines, with sides being orbits of left-invariant vector fields. We estimate the number of sides of parallelograms in a free nilpotent group and point out a relation to the rank of rational series.

[DMTCS-030202] Charles Knessl and Wojciech Szpankowski. Quicksort algorithm again revisited. *Discrete Mathematics and Theoretical Computer Science*, 3(2):43–64, 1999.

http://www.dmtcs.org/volumes/abstracts/dm030202.abs.html

We consider the standard Quicksort algorithm that sorts n distinct keys with all possible $n!$ orderings of keys being equally likely. Equivalently, we analyze the total path length $L(n)$ in a randomly built *binary search tree*. Obtaining the limiting distribution of $L(n)$ is still an outstanding open problem. In this paper, we establish an integral equation for the probability density of the number of comparisons $L(n)$. Then, we investigate the large deviations of L(n). We shall show that the left tail of the limiting distribution is much "thinner" (i.e., double exponential) than the right tail (which is only exponential). Our results contain some constants that must be determined numerically. We use formal asymptotic methods of applied mathematics such as the WKB method and matched asymptotics.

[DMTCS-030203] Manfred Göbel. The optimal lower bound for generators of invariant rings without finite SAGBI bases with respect to any admissible order. *Discrete Mathematics and Theoretical Computer Science*, 3(2):65–70, 1999.

http://www.dmtcs.org/volumes/abstracts/dm030203.abs.html

We prove the existence of an invariant ring $\mathbf{C}[X_1, ..., X_n]^T$ generated by elements with a total degree of at most 2, which has no finite SAGBI basis with respect to any admissible order. Therefore, 2 is the optimal lower bound for the total degree of generators of invariant rings with such a property.

[DMTCS-030301] Peter Bürgisser. On the structure of Valiant's complexity classes. *Discrete Mathematics and Theoretical Computer Science*, 3(3):73–94, 1999.

http://www.dmtcs.org/volumes/abstracts/dm030301.abs.html

In Valiant developed an algebraic analogue of the theory of NP-completeness for computations of polynomials over a field. We further develop this theory in the spirit of structural complexity and obtain analogues of well-known results by Baker, Gill, and Solovay, Ladner, and Schöning.
We show that if Valiant's hypothesis is true, then there is a p-definable family, which is neither p-computable nor *VNP*-complete. More generally, we define the posets of p-degrees and c-degrees of p-definable families and prove that any countable poset can be embedded in either of them, provided Valiant's hypothesis is true. Moreover, we establish the existence of minimal pairs for *VP* in *VNP*.
Over finite fields, we give a *specific* example of a family of polynomials which is neither *VNP*-complete nor p-computable, provided the polynomial hierarchy does not collapse.
We define relativized complexity classes VP^h and VNP^h and construct complete families in these classes. Moreover, we prove that there is a p-family h satisfying $VP^h = VNP^h$.

[DMTCS-030302] Kim S. Larsen. Partially persistent search trees with transcript operations. *Discrete Mathematics and Theoretical Computer Science*, 3(3):95–107, 1999.

http://www.dmtcs.org/volumes/abstracts/dm030302.abs.html

When dictionaries are persistent, it is natural to introduce a transcript operation which reports the status changes for a given key over time. We discuss when and how a time and space efficient implementation of this operation can be provided.

[DMTCS-030303] Thomas Schwentick and Klaus Barthelmann. Local normal forms for first-order logic with applications to games and automata. *Discrete Mathematics and Theoretical Computer Science*, 3(3):109–124, 1999.

http://www.dmtcs.org/volumes/abstracts/dm030303.abs.html

Building on work of Gaifman [Gai82] it is shown that every first-order formula is logically equivalent to a formula of the form $\exists x_1, ..., x_l, \forall y, \phi$ where ϕ is r-local around y, i.e. quantification in ϕ is restricted to elements of the universe of distance at most r from y.
From this and related normal forms, variants of the Ehrenfeucht game for first-order and existential monadic second-order logic are developed that restrict the possible strategies for the spoiler, one of the two players. This makes proofs of the existence of a winning strategy for the duplicator, the other player, easier and can thus simplify inexpressibility proofs.
As another application, automata models are defined that have, on arbitrary classes of relational structures, exactly the expressive power of first-order logic and existential monadic second-order logic, respectively.

[DMTCS-030304] Anna Frid. Applying a uniform marked morphism to a word. *Discrete Mathematics and Theoretical Computer Science*, 3(3):125–140, 1999.

http://www.dmtcs.org/volumes/abstracts/dm030304.abs.html

We describe the relationship between different parameters of the initial word and its image obtained by application of a uniform marked morphism. The functions described include the subword complexity, frequency of factors, and the recurrence function. The relations obtained for the image of a word can be used also for the image of a factorial language. Using induction, we give a full description of the involved functions of the fixed point of the morphism considered.

[DMTCS-030401] Hans L. Bodlaender. A note on domino treewidth. *Discrete Mathematics and Theoretical Computer Science*, 3(4):141–150, 1999.

http://www.dmtcs.org/volumes/abstracts/dm030401.abs.html

In [DO95], Ding and Oporowski proved that for every k, and d, there exists a constant $c_{k,d}$, such that every graph with treewidth at most k and maximum degree at most d has domino treewidth at most $c_{k,d}$. This note gives a new simple proof of this fact, with a better bound for $c_{k,d}$, namely $(9k+7)d(d+1)-1$. It is also shown that a lower bound of $\Omega(kd)$ holds: there are graphs with domino treewidth at least $1/12\times kd-1$, treewidth at most k, and maximum degree at most d, for many values k and d. The domino treewidth of a tree is at most its maximum degree.

[DMTCS-030402] Aaron Robertson. Permutations containing and avoiding *123* and *132* patterns. *Discrete Mathematics and Theoretical Computer Science*, 3(4):151–154, 1999.

http://www.dmtcs.org/volumes/abstracts/dm030402.abs.html

We prove that the number of permutations which avoid 132-patterns and have exactly one 123-pattern, equals $(n-2)2^{n-3}$, for $n \geq 3$. We then give a bijection onto the set of permutations which avoid 123-patterns and have exactly one 132-pattern. Finally, we show that the number of permutations which contain exactly one 123-pattern and exactly one 132-pattern is $(n-3)(n-4)2^{n-5}$, for $n \geq 5$.

[DMTCS-030403] Keqin Li. Analysis of an approximation algorithm for scheduling independent parallel tasks. *Discrete Mathematics and Theoretical Computer Science*, 3(4):155–166, 1999.

http://www.dmtcs.org/volumes/abstracts/dm030403.abs.html

In this paper, we consider the problem of scheduling independent parallel tasks in parallel systems with identical processors. The problem is NP-hard, since it includes the bin packing problem as a special case when all tasks have unit execution time. We propose and analyze a simple approximation algorithm called H_m, where m is a positive integer. Algorithm H_m has a moderate asymptotic worst-case performance ratio in the range $[4/3...31/18]$ for all $m \geq 6$; but the algorithm has a small asymptotic worst-case performance ratio in the range $[1+1/(r+1)..1+1/r]$, when task sizes do not exceed $1/r$ of the total available processors, where $r > 1$ is an integer. Furthermore, we show that if the task sizes are independent, identically distributed (i.i.d.) uniform random variables, and task execution times are i.i.d. random variables with finite mean and variance, then the average-case performance ratio of algorithm H_m is no larger than 1.2898680..., and for an exponential distribution of task sizes, it does not exceed 1.2898305.... As demonstrated by our analytical as well as numerical results, the average-case performance ratio improves significantly when tasks request for smaller numbers of processors.

[DMTCS-030404] Andrzej Proskurowski and Jan Arne Telle. Classes of graphs with restricted interval models. *Discrete Mathematics and Theoretical Computer Science*, 3(4):167–176, 1999.

http://www.dmtcs.org/volumes/abstracts/dm030404.abs.html

We introduce q-proper interval graphs as interval graphs with interval models in which no interval is properly contained in more than q other intervals, and also provide a forbidden induced subgraph characterization of this class of graphs. We initiate a graph-theoretic study of subgraphs of q-proper interval graphs with maximum clique size $k+1$ and give an equivalent characterization of these graphs by restricted path-decomposition. By allowing the parameter q to vary from 0 to k, we obtain a nested hierarchy of graph families, from graphs of bandwidth at most k to graphs of pathwidth at most k. Allowing both parameters to vary, we have an infinite lattice of graph classes ordered by containment.

[DMTCS-030405] Nathalie Caspard. A characterization for all interval doubling schemes of the lattice of permutations. *Discrete Mathematics and Theoretical Computer Science*, 3(4):177–188, 1999.

http://www.dmtcs.org/volumes/abstracts/dm030405.abs.html

The lattice $\mathbf{S}_n$ of all permutations on a n-element set has been shown to be *bounded* [CAS], which is a strong constructive property characterized by the fact that $\mathbf{S}_n$ admits what we call an *interval doubling scheme*. In this paper we characterize all interval doubling schemes of the lattice $\mathbf{S}_n$, a result that gives a nice precision on the bounded nature of the lattice of permutations. This theorem is a direct corollary of two strong properties that are also given with their proofs.

[DMTCS-030406] Herbert S. Wilf. Accelerated series for universal constants, by the WZ method. *Discrete Mathematics and Theoretical Computer Science*, 3(4):189–192, 1999.

http://www.dmtcs.org/volumes/abstracts/dm030406.abs.html

In this paper, the author presents a method, based on WZ theory, for finding rapidly converging series for universal constants. This method is analogous but different from Amdeberhan and Zeilberger's method.

[DMTCS-030407] Ralf Hinze. Polytypic functions over nested datatypes. *Discrete Mathematics and Theoretical Computer Science*, 3(4):193–214, 1999.

http://www.dmtcs.org/volumes/abstracts/dm030407.abs.html

The theory and practice of polytypic programming is intimately connected with the initial algebra semantics of datatypes. This is both a blessing and a curse. It is a blessing because the underlying theory is beautiful and well developed. It is a curse because the initial algebra semantics is restricted to so-called regular datatypes. Recent work by R. Bird and L. Meertens [3] on the semantics of non-regular or nested datatypes suggests that an extension to general datatypes is not entirely straightforward. Here we propose an alternative that extends polytypism to arbitrary datatypes, including nested datatypes and mutually recursive datatypes. The central idea is to use rational trees over a suitable set of functor symbols as type arguments for polytypic functions. Besides covering a wider range of types the approach is also simpler and technically less involving than previous ones. We present several examples of polytypic functions, among others polytypic reduction and polytypic equality. The presentation assumes some background in functional and in polytypic programming. A basic knowledge of monads is required for some of the examples.

[DMTCS-040101] Jean-Paul Allouche and Jeffrey Shallit. Sums of digits, overlaps, and palindromes. *Discrete Mathematics and Theoretical Computer Science*, 4(1):1–10, 2000.

http://www.dmtcs.org/volumes/abstracts/dm040101.abs.html

Let $s_k(n)$ denote the sum of the digits in the base-k representation of n. In a celebrated paper, Thue showed that the infinite word $(s_2(n) \bmod 2)_{n\geq 0}$ is *overlap-free*, i.e., contains no subword of the form $axaxa$ where x is any finite word and a is a single symbol. Let k, m be integers with $k > 2$, $m \geq 1$. In this paper, generalizing Thue's result, we prove that the infinite word $t_{k,m} := (s_k(n) \bmod m)_{n\geq 0}$ is overlap-free if and only if $m \geq k$. We also prove that $t_{k,m}$ contains arbitrarily long squares (i.e., subwords of the form xx where x is nonempty), and contains arbitrarily long palindromes if and only if $m \leq 2$.

[DMTCS-040102] Alexandre Boudet. Unification of higher-order patterns modulo simple syntactic equational theories. *Discrete Mathematics and Theoretical Computer Science*, 4(1):11–30, 2000.

http://www.dmtcs.org/volumes/abstracts/dm040102.abs.html

We present an algorithm for unification of higher-order patterns modulo simple syntactic equational theories as defined by Kirchner [14]. The algorithm by Miller [17] for pattern unification, refined by Nipkow [18] is first modified in order to behave as a first-order unification algorithm. Then the mutation rule for syntactic theories of Kirchner [13,14] is adapted to pattern E-unification. If the syntactic algorithm for a theory E terminates in the first-order case, then our algorithm will also terminate for pattern E-unification. The result is a DAG-solved form plus some equations of the form $\lambda\overline{x}.F(\overline{x}) = \lambda\overline{x}.F(\overline{x^\pi})$ where $\overline{x^\pi}$ is a permutation of $\overline{x}$ When all function symbols are decomposable these latter equations can be discarded, otherwise the compatibility of such equations with the solved form remains open.

[DMTCS-040103] Elena Barcucci, Alberto Del Lungo, Elisa Pergola, and Renzo Pinzani. Permutations avoiding an increasing number of length-increasing forbidden subsequences. *Discrete Mathematics and Theoretical Computer Science*, 4(1):31–44, 2000.

http://www.dmtcs.org/volumes/abstracts/dm040103.abs.html

A permutation π is said to be τ-avoiding if it does not contain any subsequence having all the same pairwise comparisons as τ. This paper concerns the characterization and enumeration of permutations which avoid a set F^j of subsequences increasing both in number and in length at the same time. Let F^j be the set of subsequences of the form $\sigma(j+1)(j+2)$, σ being any permutation on $\{1, ..., j\}$. For $j = 1$ the only subsequence in F^1 is 123 and the 123-avoiding permutations are enumerated by the Catalan numbers; for $j = 2$ the subsequences in F^2 are 1234 2134 and the $(1234, 2134)$avoiding permutations are enumerated by the Schröder numbers; for each other value of j greater than 2 the subsequences in F^j are $j!$ and their length is $(j + 2)$ the permutations avoiding these $j!$ subsequences are enumerated by a number sequence $\{a_n\}$ such that $C_n \leq a_n \leq n!$, C_n being the nth Catalan number. For each j we determine the generating function of permutations avoiding the subsequences in F^j according to the length, to the number of left minima and of non-inversions.

[DMTCS-040104] Ross M. McConnell and Jeremy P. Spinrad. Ordered vertex partitioning. *Discrete Mathematics and Theoretical Computer Science*, 4(1):45–60, 2000.

http://www.dmtcs.org/volumes/abstracts/dm040104.abs.html

A transitive orientation of a graph is an orientation of the edges that produces a transitive digraph. The modular decomposition of a graph is a canonical representation of all of its modules. Finding a transitive orientation and finding the modular decomposition are in some sense dual problems. In this paper, we describe a simple $O(n + m \log n)$ algorithm that uses this duality to find both a transitive orientation and the modular decomposition. Though the running time is not optimal, this algorithm is much simpler than any previous algorithms that are not $\Omega(n^2)$. The best known time bounds for the problems are $O(n + m)$ but they involve sophisticated techniques.

[DMTCS-040105] Klaus Dohmen. Improved inclusion-exclusion identities via closure operators. *Discrete Mathematics and Theoretical Computer Science*, 4(1):61–66, 2000.

http://www.dmtcs.org/volumes/abstracts/dm040105.abs.html

Let $(A_v)_{v \in V}$ be a finite family of sets. We establish an improved inclusion-exclusion identity for each closure operator on the power set of V having the unique base property. The result generalizes three improvements of the inclusion-exclusion principle as well as Whitney's broken circuit theorem on the chromatic polynomial of a graph.

[DMTCS-040106] Toufik Mansour and Alek Vainshtein. Avoiding maximal parabolic subgroups of S_k. *Discrete Mathematics and Theoretical Computer Science*, 4(1):81–90, 2000.

http://www.dmtcs.org/volumes/abstracts/dm040106.abs.html

We find an explicit expression for the generating function of the number of permutations in S_n avoiding a subgroup of S_k generated by all but one simple transpositions. The generating function turns out to be rational, and its denominator is a rook polynomial for a rectangular board.

[DMTCS-040201] Anna Bernasconi. On a hierarchy of Boolean functions hard to compute in constant depth. *Discrete Mathematics and Theoretical Computer Science*, 4(2):79–90, 2001.

http://www.dmtcs.org/volumes/abstracts/dm040201.abs.html

Any attempt to find connections between mathematical properties and complexity has a strong relevance to the field of Complexity Theory. This is due to the lack of mathematical techniques to prove lower bounds for general models of computation.
This work represents a step in this direction: we define a combinatorial property that makes Boolean functions "*hard*" to compute in constant depth and show how the harmonic analysis on the hypercube can be applied to derive new lower bounds on the size complexity of previously unclassified Boolean functions.

[DMTCS-040202] Johannes Grassberger and Günther Hörmann. A note on representations of the finite Heisenberg group and sums of greatest common divisors. *Discrete Mathematics and Theoretical Computer Science*, 4(2):91–100, 2001.

http://www.dmtcs.org/volumes/abstracts/dm040202.abs.html

We review an elementary approach to the construction of all irreducible representations of the finite Heisenberg group. Determining the number of inequivalent classes of irreducible representations by different methods leads to an identity of sums involving greatest common divisors. We show how this identity can be generalized and derive an explicit formula for the sums.

[DMTCS-040203] Roberto Mantaci and Fanja Rakotondrajao. A permutations representation that knows what "Eulerian" means. *Discrete Mathematics and Theoretical Computer Science*, 4(2):101–108, 2001.

http://www.dmtcs.org/volumes/abstracts/dm040203.abs.html

Eulerian numbers (and "Alternate Eulerian numbers") are often interpreted as distributions of statistics defined over the Symmetric group. The main purpose of this paper is to define a way to represent permutations that provides some other combinatorial interpretations of these numbers. This representation uses a one-to-one correspondence between permutations and the so-called *subexceedant functions*.

[DMTCS-040204] Chính T. Hoàng and Van Bang Le. P_4-colorings and P_4-bipartite graphs. *Discrete Mathematics and Theoretical Computer Science*, 4(2):109–122, 2001.

http://www.dmtcs.org/volumes/abstracts/dm040204.abs.html

A vertex partition of a graph into disjoint subsets V_is is said to be a P_4-free coloring if each color class V_i induces a subgraph without chordless path on four vertices (denoted by P_4). Examples of P_4-free 2-colorable graphs (also called P_4-bipartite graphs) include parity graphs and graphs with "few" P_4s like P_4-reducible and P_4-sparse graphs. We prove that, given $k \geq 2$, *P_4-Free k-Colorability* is NP-complete even for comparability graphs, and for P_5-free graphs. We then discuss the recognition, perfection and the Strong Perfect Graph Conjecture (SPGC) for P_4-bipartite graphs with special P_4-structure. In particular, we show that the SPGC is true for P_4-bipartite graphs with one P_3-free color class meeting every P_4 at a midpoint.

[DMTCS-040205] Eugene Curtin. Cubic Cayley graphs with small diameter. *Discrete Mathematics and Theoretical Computer Science*, 4(2):123–132, 2001.

http://www.dmtcs.org/volumes/abstracts/dm040205.abs.html

In this paper we apply Polya's Theorem to the problem of enumerating Cayley graphs on permutation groups up to isomorphisms induced by conjugacy in the symmetric group. We report the results of a search of all three-regular Cayley graphs on permutation groups of degree at most nine for small diameter graphs. We explore several methods of constructing covering graphs of these Cayley graphs. Examples of large graphs with small diameter are obtained.

[DMTCS-040206] C. R. Subramanian. Paths of specified length in random k-partite graphs. *Discrete Mathematics and Theoretical Computer Science*, 4(2):133–138, 2001.

http://www.dmtcs.org/volumes/abstracts/dm040206.abs.html

Fix positive integers k and l. Consider a random k-partite graph on n vertices obtained by partitioning the vertex set into $V_i, (i = 1, \ldots, k)$ each having size $\Omega(n)$ and choosing each possible edge with probability p. Consider any vertex x in any V_i and any vertex y. We show that the expected number of simple paths of even length l between x and y differ significantly depending on whether y belongs to the same V_i (as x does) or not. A similar phenomenon occurs when l is odd. This result holds even when k, l vary slowly with n. This fact has implications to coloring random graphs. The proof is based on establishing bijections between sets of paths.

[DMTCS-040207] Nir Menakerman and Raphael Rom. Analysis of transmissions scheduling with packet fragmentation. *Discrete Mathematics and Theoretical Computer Science*, 4(2):139–156, 2001.

http://www.dmtcs.org/volumes/abstracts/dm040207.abs.html

We investigate a scheduling problem in which packets, or datagrams, may be fragmented. While there are a few applications to scheduling with datagram fragmentation, our model of the problem is derived from a scheduling problem present in data over CATV networks. In the scheduling problem datagrams of variable lengths must be assigned (packed) into fixed length time slots. One of the capabilities of the system is the ability to break a datagram into several fragments. When a datagram is fragmented, extra bits are added to the original datagram to enable the reassembly of all the fragments. We convert the scheduling problem into the problem of bin packing with item fragmentation, which we define in the following way: we are asked to pack a list of items into a minimum number of unit capacity bins. Each item may be fragmented in which case overhead units are added to the size of every fragment. The cost associated with fragmentation renders the problem NP-hard, therefore an approximation algorithm is needed. We define a version of the well-known Next-Fit algorithm, capable of fragmenting items, and investigate its performance. We present both worst case and average case results and compare them to the case where fragmentation is not allowed.

[DMTCS-040208] David Krumme and Paraskevi Fragopoulou. Minimum eccentricity multicast trees. *Discrete Mathematics and Theoretical Computer Science*, 4(2):157–172, 2001.

http://www.dmtcs.org/volumes/abstracts/dm040208.abs.html

We consider the problem of constructing a multicast tree that connects a group of source nodes to a group of sink nodes (receivers) and minimizes the maximum end-to-end delay between any pair of source/sink nodes. This is known as the *minimum eccentricity multicast tree* problem, and is directly related to the quality of service requirements of real multipoint applications. We deal directly with the problem in its general form, meaning that the sets of source and sink nodes need not be overlapping nor disjoint. The main contribution of this work is a polynomial algorithm for this problem on general networks which is inspired by an innovative method that uses geometric relationships on the xy-plane.

[DMTCS-040209] Michel Habib, Christophe Paul, and Laurent Viennot. Linear time recognition of P_4-indifference graphs. *Discrete Mathematics and Theoretical Computer Science*, 4(2):173–178, 2001.

http://www.dmtcs.org/volumes/abstracts/dm040209.abs.html

A graph is a P_4-indifference graph if it admits an ordering $<$ on its vertices such that every chordless path with vertices a, b, c, d and edges ab, bc, cd has $a < b < c < d$ or $d < c < b < a$. We present a linear time recognition for these graphs.

[DMTCS-040210] Timo Peichl and Heribert Vollmer. Finite automata with generalized acceptance criteria. *Discrete Mathematics and Theoretical Computer Science*, 4(2):179–192, 2001.

http://www.dmtcs.org/volumes/abstracts/dm040210.abs.html

We examine the power of nondeterministic finite automata with acceptance of an input word defined by a leaf language, i.e., a condition on the sequence of leaves in the automaton's computation tree. We study leaf languages either taken from one of the classes of the Chomsky hierarchy, or taken from a time- or space-bounded complexity class. We contrast the obtained results with those known for leaf languages for Turing machines and Boolean circuits.

[DMTCS-040211] Martin Müller, Joachim Niehren, and Ralf Treinen. The first-order theory of ordering constraints over feature trees. *Discrete Mathematics and Theoretical Computer Science*, 4(2):193–234, 2001.

http://www.dmtcs.org/volumes/abstracts/dm040211.abs.html

The system $FT_{\leq}$ of ordering constraints over feature trees has been introduced as an extension of the system FT of equality constraints over feature trees. We investigate the first-order theory of $FT_{\leq}$ and its fragments in detail, both over finite trees and over possibly infinite trees. We prove that the first-order theory of $FT_{\leq}$ is undecidable, in contrast to the first-order theory of FT which is well-known to be decidable. We show that the entailment problem of $FT_{\leq}$ with existential quantification is PSPACE-complete. So far, this problem has been shown decidable, coNP-hard in case of finite trees, PSPACE-hard in case of arbitrary trees, and cubic time when restricted to quantifier-free entailment judgments. To show PSPACE-completeness, we show that the entailment problem of $FT_{\leq}$ with existential quantification is equivalent to the inclusion problem of non-deterministic finite automata.

[DMTCS-040212] C. D. Randazzo, H. P. L. Luna, and P. Mahey. Benders decomposition for local access network design with two technologies. *Discrete Mathematics and Theoretical Computer Science*, 4(2):235–246, 2001.

http://www.dmtcs.org/volumes/abstracts/dm040212.abs.html

We have worked with the local access network design problem with two cable technologies. This is an optimization problem in graphs that consists of linking an origin node to a set of terminal nodes which have a flow demand. There are also a set of Steiner or transshipment nodes which do not have demand. Each arc of the graph has two associated costs: a variable cost depending on the flow through the arc and a fixed cost associated with the installation of the arc. Moreover, in each arc we can install one of two available technologies: optical fiber or copper (we can also use radio links with any other cable technology). Each one of these technologies has different variable and fixed costs. To be more precise, the fixed cost of the optical fiber is greater than that of the copper, but its variable cost is much smaller. The problem was modeled using a multicommodity flow formulation in which we added some structural constraints. This model was used to apply the Benders decomposition method. The structural constraints have the objective of trying to guarantee that the master problem of the Benders decomposition will yield a tree. The Benders subproblems are trivial network flow problems. The dual variables have commodity meaningfull values and are evaluated in a systematic form. The algorithm was implemented in C++ with CPLEX 3.0 callable library. We have tested the algorithm with some test instances obtained by a generator of problems that we developed.

[DMTCS-040213] Vince Grolmusz. A degree-decreasing lemma for $(MOD_q - MOD_p)$ circuits. *Discrete Mathematics and Theoretical Computer Science*, 4(2):247–254, 2001.

http://www.dmtcs.org/volumes/abstracts/dm040213.abs.html

Consider a (MOD_q, MOD_p) circuit, where the inputs of the bottom MOD_p gates are degree-d polynomials with integer coefficients of the input variables (p, q are different primes). Using our main tool — the Degree Decreasing Lemma — we show that this circuit can be converted to a (MOD_q, MOD_p) circuit with *linear* polynomials on the input-level with the price of increasing the size of the circuit. This result has numerous consequences: for the Constant Degree Hypothesis of Barrington, Straubing and Thérien, and generalizing the lower bound results of Yan and Parberry, Krause and Waack, and Krause and Pudlák. Perhaps the most important application is an exponential lower bound for the size of (MOD_q, MOD_p) circuits computing the n fan-in AND, where the input of each MOD_p gate at the bottom is an *arbitrary* integer valued function of cn variables $(c < 1)$ plus an arbitrary linear function of n input variables.

[DMTCS-040214] Damien Magoni and Jean-Jacques Pansiot. Oriented multicast routing algorithm applied to network-level agent search. *Discrete Mathematics and Theoretical Computer Science*, 4(2):255–272, 2001.

http://www.dmtcs.org/volumes/abstracts/dm040214.abs.html

Many protocols need a discovery mechanism to enable a given node to locate one or several nodes involved in the same communication. However, there is no protocol ready to fulfill this service at the network-layer. Every protocol usually implements its own solution. In particular, multicast protocols often use a searching technique based on an algorithm called expanding rings search. This algorithm searches for nodes in all directions and thus uses much bandwidth. However a typical search can usually restrict its scan in a specific direction. To enable this broadcast restriction, we propose an oriented multicast routing algorithm. The algorithm's principle is to direct the multicast of packets towards a special node, involved in the communication, in order to search only in a limited area. The area must be as small as possible to reduce network flooding but still has to contain many nodes satisfying the search criteria. This new algorithm is the core part of a network-level node search framework also defined herein. A search protocol based on this framework could provide a network-level agent discovery service to current protocols. We have simulated an agent search with our algorithm on one side and with the expanding rings' algorithm on the other side and we give comparative results.

[DMTCS-040215] Ján Maňuch. Defect effect of bi-infinite words in the two-element case. *Discrete Mathematics and Theoretical Computer Science*, 4(2):273–290, 2001.

http://www.dmtcs.org/volumes/abstracts/dm040215.abs.html

Let X be a two-element set of words over a finite alphabet. If a bi-infinite word possesses two X-factorizations which are not shiftequivalent, then the primitive roots of the words in X are conjugates. Note, that this is a strict sharpening of a defect theorem for bi-infinite words stated in *KMP*. Moreover, we prove that there is at most one bi-infinite word possessing two different X-factorizations and give a necessary and sufficient conditions on X for the existence of such a word. Finally, we prove that the family of sets X for which such a word exists is parameterizable.

[DMTCS-040216] Lawrence S. Moss. Simple equational specifications of rational arithmetic. *Discrete Mathematics and Theoretical Computer Science*, 4(2):291–300, 2001.

http://www.dmtcs.org/volumes/abstracts/dm040216.abs.html

We exhibit an initial specification of the rational numbers equipped with addition, subtraction, multiplication, greatest integer function, and absolute value. Our specification uses only the sort of rational numbers. It uses one hidden function; that function is unary. But it does not use an error constant, or extra (hidden) sorts, or conditional equations. All of our work is elementary and self-contained.

[DMTCS-040217] Jessica H. Fong and Martin Strauss. An approximate L^p difference algorithm for massive data streams. *Discrete Mathematics and Theoretical Computer Science*, 4(2):301–322, 2001.

http://www.dmtcs.org/volumes/abstracts/dm040217.abs.html

Several recent papers have shown how to approximate the difference $\sum_i |a_i - b_i|$ or $\sum |a_i - b_i|^2$ between two functions, when the function values a_i and b_i are given in a data stream, and their order is chosen by an adversary. These algorithms use little space (much less than would be needed to store the entire stream) and little time to process each item in the stream. They approximate with small relative error. Using different techniques, we show how to approximate the L^p-difference $\sum_i |a_i - b_i|^p$ for any rational-valued $p \in (0, 2]$, with comparable efficiency and error. We also show how to approximate $\sum_i |a_i - b_i|^p$ for larger values of p but with a worse error guarantee. Our results fill in gaps left by recent work, by providing an algorithm that is precisely tunable for the application at hand. These results can be used to assess the difference between two chronologically or physically separated massive data sets, making one quick pass over each data set, without buffering the data or requiring the data source to pause. For example, one can use our techniques to judge whether the traffic on two remote network routers are similar without requiring either router to transmit a copy of its traffic. A web search engine could use such algorithms to construct a library of small "sketches," one for each distinct page on the web; one can approximate the extent to which new web pages duplicate old ones by comparing the sketches of the web pages. Such techniques will become increasingly important as the enormous scale, distributional nature, and one-pass processing requirements of data sets become more commonplace.

[DMTCS-040218] Gabrielle Assunta Grün. An efficient algorithm for the maximum distance problem. *Discrete Mathematics and Theoretical Computer Science*, 4(2):323–350, 2001.

http://www.dmtcs.org/volumes/abstracts/dm040218.abs.html

Efficient algorithms for temporal reasoning are essential in knowledge-based systems. This is central in many areas of Artificial Intelligence including scheduling, planning, plan recognition, and natural language understanding. As such, scalability is a crucial consideration in temporal reasoning. While reasoning in the interval algebra is NP-complete, reasoning in the less expressive point algebra is tractable. In this paper, we explore an extension to the work of Gerevini and Schubert which is based on the point algebra. In their seminal framework, temporal relations are expressed as a directed acyclic graph partitioned into chains and supported by a *metagraph* data structure, where time points or events are represented by vertices, and directed edges are labelled with $<$ or $\leq$. They are interested in fast algorithms for determining the strongest relation between two events. They begin by developing fast algorithms for the case where all points lie on a chain. In this paper, we are interested in a generalization of this, namely we consider the problem of finding the maximum "distance" between two vertices in a *chain*; this problem arises in real world applications such as in process control and crew scheduling. We describe an $O(n)$ time preprocessing algorithm for the maximum distance problem on chains. It allows queries for the maximum number of $<$ edges between two vertices to be answered in $O(1)$ time. This matches the performance of the algorithm of Gerevini and Schubert for determining the strongest relation holding between two vertices in a chain.

[DMTCS-040219] Pascal Koiran. The topological entropy of iterated piecewise affine maps is uncomputable. *Discrete Mathematics and Theoretical Computer Science*, 4(2):351–356, 2001.

http://www.dmtcs.org/volumes/abstracts/dm040219.abs.html

We show that it is impossible to compute (or even to approximate) the topological entropy of a continuous piecewise affine function in dimension four. The same result holds for saturated linear functions in unbounded dimension. We ask whether the topological entropy of a piecewise affine function is always a computable real number, and conversely whether every non-negative computable real number can be obtained as the topological entropy of a piecewise affine function. It seems that these two questions are also open for cellular automata.

[DMTCS-040220] Anna Frid. Overlap-free symmetric D0L words. *Discrete Mathematics and Theoretical Computer Science*, 4(2):357–362, 2001.

http://www.dmtcs.org/volumes/abstracts/dm040220.abs.html

A D0L word on an alphabet $\Sigma = \{0, 1, \ldots, q-1\}$ is called symmetric if it is a fixed point $w = \varphi(w)$ of a morphism $\varphi : \Sigma^* \to \Sigma^*$ defined by $\varphi(i) = \overline{t_1 + i}\,\overline{t_2 + i} \ldots \overline{t_m + i}$ for some word $t_1 t_2 \ldots t_m$ (equal to $\varphi(0)$) and every $i \in \Sigma$; here $\overline{a}$ means $a \bmod q$. We prove a result conjectured by J. Shallit: if all the symbols in $\varphi(0)$ are distinct (i.e., if $t_i \neq t_j$ for $i \neq j$), then the symmetric D0L word w is overlap-free, i.e., contains no factor of the form $axaxa$ for any $x \in \Sigma^*$ and $a \in \Sigma$.

[DMTCS-040221] Werner Schachinger. Asymptotic normality of recursive algorithms via martingale difference arrays. *Discrete Mathematics and Theoretical Computer Science*, 4(2):363–398, 2001.

http://www.dmtcs.org/volumes/abstracts/dm040221.abs.html

We propose martingale central limit theorems as an tool to prove asymptotic normality of the costs of certain recursive algorithms which are subjected to random input data. The recursive algorithms that we have in mind are such that if input data of size N produce random costs L_N, then $L_N =^D L_n + L_{N-n} + R_N$ for $N \geq n_0 \geq 2$, where n follows a certain distribution P_N on the integers $\{0, \ldots, N\}$ and $L_k =^D L_k$ for $k \geq 0$. L_n, L_{N-n} and R_N are independent, conditional on n, and R_N are random variables, which may also depend on n, corresponding to the cost of splitting the input data of size N (into subsets of size n and $N-n$) and combining the results of the recursive calls to yield the overall result. We construct a martingale difference array with rows converging to $Z_N := [L_N - EL_N]/[\sqrt{VarL_N}]$. Under certain compatibility assumptions on the sequence $(P_N)_{N\geq 0}$ we show that a pair of sufficient conditions (of Lyapunov type) for $Z_N \to^D N(0,1)$ can be restated as a pair of conditions regarding asymptotic relations between three sequences. All these sequences satisfy the same type of linear equation, that is also the defining equation for the sequence $(EL_N)_{N\geq 0}$ and thus very likely a well studied object. In the case that the P_N are binomial distributions with the same parameter p, and for deterministic R_N, we demonstrate the power of this approach. We derive very general sufficient conditions in terms of the sequence $(R_N)_{N\geq 0}$ (and for the scale $R_N = N^\alpha$ a characterization of those α) leading to asymptotic normality of Z_N.

[DMTCS-050101] Markus E. Nebel. The stack-size of combinatorial tries revisited. *Discrete Mathematics and Theoretical Computer Science*, 5(1):1–16, 2002.

http://www.dmtcs.org/volumes/abstracts/dm050101.abs.html

In the present paper we consider a generalized class of extended binary trees in which leaves are distinguished in order to represent the location of a key within a trie of the same structure. We prove an exact asymptotic equivalent to the average stack-size of trees with α internal nodes and β leaves corresponding to keys; we assume that all trees with the same parameters α and β have the same probability. The assumption of that uniform model is motivated for example by the usage of tries for the compression of blockcodes. Furthermore, we will prove asymptotics for the r-th moments of the stack-size and we will show that a normalized stack-size possesses a theta distribution in the limit.

[DMTCS-050102] Anton Černý. Lyndon factorization of generalized words of Thue. *Discrete Mathematics and Theoretical Computer Science*, 5(1):17–46, 2002.

http://www.dmtcs.org/volumes/abstracts/dm050102.abs.html

The i-th symbol of the well-known infinite word of Thue on the alphabet $\{0,1\}$ can be characterized as the parity of the number of occurrences of the digit 1 in the binary notation of i. Generalized words of Thue are based on counting the parity of occurrences of an arbitrary word $w \in \{0,1\}^+ - 0^*$ in the binary notation of i. We provide here the standard Lyndon factorization of some subclasses of this class of infinite words.

[DMTCS-050103] Kenneth G. Monks. $3x+1$ minus the $+$. *Discrete Mathematics and Theoretical Computer Science*, 5(1):47–54, 2002.

http://www.dmtcs.org/volumes/abstracts/dm050103.abs.html

We use Conway's *Fractran* language to derive a function $R : \mathbf{Z}^+ \rightarrow \mathbf{Z}^+$ of the form $R(n) = r_i n \; if \; n \equiv i \bmod d$ where d is a positive integer, $0 \leq i < d$ and $r_0, r_1, \; ... \; r_{d-1}$ are rational numbers, such that the famous $3x + 1$ conjecture holds if and only if the R-orbit of 2^n contains 2 for all positive integers n. We then show that the R-orbit of an arbitrary positive integer is a constant multiple of an orbit that contains a power of 2. Finally we apply our main result to show that any cycle $\{x_0, \; ... \; , x_{m-1}\}$ of positive integers for the $3x + 1$ function must satisfy
$\sum_{i \in \mathbf{E}} \lfloor x_i/2 \rfloor = \sum_{i \in \mathbf{O}} \lfloor x_i/2 \rfloor + k$.
where $\mathbf{O} = \{i \; : \; x_i \; is \; odd\}$, $\mathbf{E} = \{i \; : \; x_i \; is \; even\}$, and $k = |\mathbf{O}|$.
The method used illustrates a general mechanism for deriving mathematical results about the iterative dynamics of arbitrary integer functions from *Fractran* algorithms.

[DMTCS-050104] Christian Capelle, Michel Habib, and Fabien de Montgolfier. Graph decompositions and factorizing permutations. *Discrete Mathematics and Theoretical Computer Science*, 5(1):55–70, 2002.

http://www.dmtcs.org/volumes/abstracts/dm050104.abs.html

A factorizing permutation of a given graph is simply a permutation of the vertices in which all decomposition sets appear to be factors. Such a concept seems to play a central role in recent papers dealing with graph decomposition. It is applied here for modular decomposition and we propose a linear algorithm that computes the whole decomposition tree when a factorizing permutation is provided. This algorithm can be seen as a common generalization of Ma and Hsu for modular decomposition of chordal graphs and Habib, Huchard and Spinrad for inheritance graphs decomposition. It also suggests many new decomposition algorithms for various notions of graph decompositions.

[DMTCS-050105] Guy Louchard and Helmut Prodinger. Probabilistic analysis of Carlitz compositions. *Discrete Mathematics and Theoretical Computer Science*, 5(1):71–96, 2002.

http://www.dmtcs.org/volumes/abstracts/dm050105.abs.html

Using generating functions and limit theorems, we obtain a stochastic description of Carlitz compositions of large integer n (i.e. compositions two successive parts of which are different). We analyze: the number M of parts, the number of compositions $T(m, n)$ with m parts, the distribution of the last part size, the correlation between two successive parts, leading to a Markov chain. We describe also the associated processes and the limiting trajectories, the width and thickness of a composition. We finally present a typical simulation. The limiting processes are characterized by Brownian Motion and some discrete distributions.

[DMTCS-050106] Michael Drmota and Helmut Prodinger. The height of q-binary search trees. *Discrete Mathematics and Theoretical Computer Science*, 5(1):97–108, 2002.

http://www.dmtcs.org/volumes/abstracts/dm050106.abs.html

q-binary search trees are obtained from words, equipped with a geometric distribution instead of permutations. The average and variance of the heighth computated, based on random words of length n, as well as a Gaussian limit law.

[DMTCS-050107] Clémentin Tayou Djamegni. Synthesis of space-time optimal systolic algorithms for the Cholesky factorization. *Discrete Mathematics and Theoretical Computer Science*, 5(1):109–120, 2002.

http://www.dmtcs.org/volumes/abstracts/dm050107.abs.html

In this paper we study the synthesis of space-time optimal systolic arrays for the Cholesky Factorization (CF). First, we discuss previous allocation methods and their application to CF. Second, stemming from a new allocation method we derive a space-time optimal array, with nearest neighbor connections, that requires $3N + \Theta(1)$ time steps and $N^2/8 + \Theta(N)$ processors, where N is the size of the problem. The number of processors required by this new design improves the best previously known bound, $N^2/6 + \Theta(N)$, induced by previous allocation methods. This is the first contribution of the paper. The second contribution stemms from the fact that the paper also introduces a new allocation method that suggests to first perform clever index transformations on the initial dependence graph of a given system of uniform recurrent equations before applying the weakest allocation method, the projection method.

[DMTCS-050108] Gregory Constantine. Multicolored isomorphic spanning trees in complete graphs. *Discrete Mathematics and Theoretical Computer Science*, 5(1):121–126, 2002.

http://www.dmtcs.org/volumes/abstracts/dm050108.abs.html

Can a complete graph on an even number n (> 4) of vertices be properly edge-colored with $n - 1$ colors in such a way that the edges can be partitioned into edge disjoint colorful isomorphic spanning trees? A spanning treee is colorful if all $n - 1$ colors occur among its edges. It is proved that this is possible to accomplish whenever n is a power of two, or five times a power of two.

[DMTCS-050109] Luitpold Babel, Andreas Brandstädt, and Van Bang Le. Recognizing the P_4-structure of claw-free graphs and a larger graph class. *Discrete Mathematics and Theoretical Computer Science*, 5(1):127–146, 2002.

http://www.dmtcs.org/volumes/abstracts/dm050109.abs.html

The P_4-structure of a graph G is a hypergraph $\mathbf{H}$ on the same vertex set such that four vertices form a hyperedge in $\mathbf{H}$ 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 and of (banner,chair,dart)-free graphs. The algorithm relies on new structural results for (banner,chair,dart)-free graphs which are based on the concept of p-connectedness. As a byproduct, we obtain a polynomial time criterion for perfectness for a large class of graphs properly containing claw-free graphs.

[DMTCS-050110] Elias Dahlhaus, Jens Gustedt, and Ross M. McConnell. Partially complemented representations of digraphs. *Discrete Mathematics and Theoretical Computer Science*, 5(1):147–168, 2002.

http://www.dmtcs.org/volumes/abstracts/dm050110.abs.html

A *complementation operation* on a vertex of a digraph changes all outgoing arcs into non-arcs, and outgoing non-arcs into arcs. This defines an equivalence relation where two digraphs are equivalent if one can be obtained from the other by a sequence of such operations. We show that given an adjacency-list representation of a digraph G, many fundamental graph algorithms can be carried out on any member G' of G's equivalence class in $O(n+m)$ time, where m is the number of arcs in G, not the number of arcs in G'. This may have advantages when G' is much larger than G. We use this to generalize to digraphs a simple $O(n+m\log n)$ algorithm of McConnell and Spinrad for finding the modular decomposition of undirected graphs. A key step is finding the strongly-connected components of a digraph F in G's equivalence class, where F may have $\omega(m\log n)$ arcs.

[DMTCS-050111] John Ellis, Hongbing Fan, and Jeffrey Shallit. The cycles of the multiway perfect shuffle permutation. *Discrete Mathematics and Theoretical Computer Science*, 5(1):169–180, 2002.

http://www.dmtcs.org/volumes/abstracts/dm050111.abs.html

The (k,n)-perfect shuffle, a generalisation of the 2-way perfect shuffle, cuts a deck of kn cards into k equal size decks and interleaves them perfectly with the first card of the last deck at the top, the first card of the second-to-last deck as the second card, and so on. It is formally defined to be the permutation $\rho_{k,n}:\ i \to ki \mod (kn+1)$, for $1 \le i \le kn$. We uncover the cycle structure of the (k,n)-perfect shuffle permutation by a group-theoretic analysis and show how to compute representative elements from its cycles by an algorithm using $O(kn)$ time and $O((\log kn)^2)$ space. Consequently it is possible to realise the (k,n)-perfect shuffle via an in-place, linear-time algorithm. Algorithms that accomplish this for the 2-way shuffle have already been demonstrated.

[DMTCS-050112] W.M.B. Dukes. On a unimodality conjecture in matroid theory. *Discrete Mathematics and Theoretical Computer Science*, 5(1):181–190, 2002.

http://www.dmtcs.org/volumes/abstracts/dm050112.abs.html

A certain unimodal conjecture in matroid theory states the number of rank-r matroids on a set of size n is unimodal in r and attains its maximum at $r = \lfloor n/2 \rfloor$. We show that this conjecture holds up to $r = 3$ by constructing a map from a class of rank-2 matroids into the class of loopless rank-3 matroids. Similar inequalities are proven for the number of non-isomorphic loopless matroids, loopless matroids and matroids.

[DMTCS-050113] J. L. Dornstetter, D. Krob, J. Y. Thibon, and E. A. Vassilieva. Performance analysis of demodulation with diversity – a combinatorial approach I: Symmetric function theoretical methods. *Discrete Mathematics and Theoretical Computer Science*, 5(1):191–204, 2002.

http://www.dmtcs.org/volumes/abstracts/dm050113.abs.html

This paper is devoted to the presentation of a combinatorial approach, based on the theory of symmetric functions, for analyzing the performance of a family of demodulation methods used in mobile telecommunications.

[DMTCS-050114] Nikolaos Fountoulakis and Colin McDiarmid. Upper bounds on the non-3-colourability threshold of random graphs. *Discrete Mathematics and Theoretical Computer Science*, 5(1):205–226, 2002.

http://www.dmtcs.org/volumes/abstracts/dm050114.abs.html

We present a full analysis of the expected number of 'rigid' 3-colourings of a sparse random graph. This shows that, if the average degree is at least 4.99, then as $n \to \infty$ the expected number of such colourings tends to 0 and so the probability that the graph is 3-colourable tends to 0. (This result is tight, in that with average degree 4.989 the expected number tends to ∞.) This bound appears independently in Kaporis *et al.* [Kap]. We then give a minor improvement, showing that the probability that the graph is 3-colourable tends to 0 if the average degree is at least 4.989.

[DMTCS-050115] Frédéric Saubion and Igor Stéphan. A unified framework to compute over tree synchronized grammars and primal grammars. *Discrete Mathematics and Theoretical Computer Science*, 5(1):227–262, 2002.

http://www.dmtcs.org/volumes/abstracts/dm050115.abs.html

Tree languages are powerful tools for the representation and schematization of infinite sets of terms for various purposes (unification theory, verification and specification ...). In order to extend the regular tree language framework, more complex formalisms have been developed. In this paper, we focus on Tree Synchronized Grammars and Primal Grammars which introduce specific control structures to represent non regular sets of terms. We propose a common unified framework in order to achieve the membership test for these particular languages. Thanks to a proof system, we provide a full operational framework, that allows us to transform tree grammars into Prolog programs (as it already exists for word grammars with DCG) whose goal is to recognize terms of the corresponding language.

[DMTCS-060101] Alexander Burstein and Toufik Mansour. Counting occurrences of some subword patterns. *Discrete Mathematics and Theoretical Computer Science*, 6(1):1–12, 2003.

http://www.dmtcs.org/volumes/abstracts/dm060101.abs.html

We find generating functions the number of strings (words) containing a specified number of occurrences of certain types of order-isomorphic classes of substrings called subword patterns. In particular, we find generating functions for the number of strings containing a specified number of occurrences of a given 3-letter subword pattern.

[DMTCS-060102] Cedric Chauve. A bijection between planar constellations and some colored Lagrangian trees. *Discrete Mathematics and Theoretical Computer Science*, 6(1):13–40, 2003.

http://www.dmtcs.org/volumes/abstracts/dm060102.abs.html

Constellations are colored planar maps that generalize different families of maps (planar maps, bipartite planar maps, bi-Eulerian planar maps, planar cacti, ...) and are strongly related to factorizations of permutations. They were recently studied by Bousquet-Mélou and Schaeffer who describe a correspondence between these maps and a family of trees, called Eulerian trees. In this paper, we derive from their result a relationship between planar constellations and another family of trees, called stellar trees. This correspondence generalizes a well known result for planar cacti, and shows that planar constellations are colored Lagrangian objects (that is objects that can be enumerated by the Good-Lagrange formula). We then deduce from this result a new formula for the number of planar constellations having a given face distribution, different from the formula one can derive from the results of Bousquet-Mélou and Schaeffer, along with systems of functional equations for the generating functions of bipartite and bi-Eulerian planar maps enumerated according to the partition of faces and vertices.

[DMTCS-060103] Vince Grolmusz. A note on set systems with no union of cardinality 0 modulo m. *Discrete Mathematics and Theoretical Computer Science*, 6(1):41–44, 2003.

http://www.dmtcs.org/volumes/abstracts/dm060103.abs.html

Alon, Kleitman, Lipton, Meshulam, Rabin and *Spencer* (Graphs. Combin. 7 (1991), no. 2, 97-99) proved, that for any hypergraph $\boldsymbol{F} = \{F_1, F_2, \ldots, F_{d(q-1)+1}\}$, where q is a prime-power, and d denotes the maximal degree of the hypergraph, there exists an $\boldsymbol{F}_0 \subset \boldsymbol{F}$, such that $|\bigcup_{F \in \boldsymbol{F}_0} F| \equiv 0(q)$. We give a direct, alternative proof for this theorem, and we also show that an explicit construction exists for a hypergraph of degree d and size $\Omega(d^2)$ which does not contain a non-empty sub-hypergraph with a union of size 0 modulo 6, consequently, the theorem does not generalize for non-prime-power moduli.

[DMTCS-060104] Brice Effantin and Hamamache Kheddouci. The b-chromatic number of power graphs. *Discrete Mathematics and Theoretical Computer Science*, 6(1):45–54, 2003.

http://www.dmtcs.org/volumes/abstracts/dm060104.abs.html

The b-chromatic number of a graph G is defined as the maximum number k of colors that can be used to color the vertices of G, such that we obtain a proper coloring and each color i, with $1 \leq i \leq k$, has at least one representant x_i adjacent to a vertex of every color j, $1 \leq j \neq i \leq k$. In this paper, we discuss the b-chromatic number of some power graphs. We give the exact value of the b-chromatic number of power paths and power complete binary trees, and we bound the b-chromatic number of power cycles.

[DMTCS-060105] Johann Cigler. Some algebraic aspects of Morse code sequences. *Discrete Mathematics and Theoretical Computer Science*, 6(1):55–68, 2003.

http://www.dmtcs.org/volumes/abstracts/dm060105.abs.html

Morse code sequences are very useful to give combinatorial interpretations of various properties of Fibonacci numbers. In this note we study some algebraic and combinatorial aspects of Morse code sequences and obtain several q-analogues of Fibonacci numbers and Fibonacci polynomials and their generalizations.

[DMTCS-060106] Klaus Dohmen, André Poenitz, and Peter Tittmann. A new two-variable generalization of the chromatic polynomial. *Discrete Mathematics and Theoretical Computer Science*, 6(1):69–90, 2003.

http://www.dmtcs.org/volumes/abstracts/dm060106.abs.html

We present a two-variable polynomial, which simultaneously generalizes the chromatic polynomial, the independence polynomial, and the matching polynomial of a graph. This new polynomial satisfies both an edge decomposition formula and a vertex decomposition formula. We establish two general expressions for this new polynomial: one in terms of the broken circuit complex and one in terms of the lattice of forbidden colorings. We show that the new polynomial may be considered as a specialization of Stanley's chromatic symmetric function. We finally give explicit expressions for the generalized chromatic polynomial of complete graphs, complete bipartite graphs, paths, and cycles, and show that it can be computed in polynomial time for trees and graphs of restricted pathwidth.

[DMTCS-060107] Charles Knessl. Numerical studies of the asymptotic height distribution in binary search trees. *Discrete Mathematics and Theoretical Computer Science*, 6(1):91–100, 2003.

http://www.dmtcs.org/volumes/abstracts/dm060107.abs.html

We study numerically a non-linear integral equation that arises in the study of binary search trees. If the tree is constructed from n elements, this integral equation describes the asymptotic (as $n\to\infty$) distribution of the height of the tree. This supplements some asymptotic results we recently obtained for the tails of the distribution. The asymptotic height distribution is shown to be unimodal with highly asymmetric tails.

[DMTCS-060108] Peter Paule and Helmut Prodinger. Fountains, histograms, and q-identities. *Discrete Mathematics and Theoretical Computer Science*, 6(1):101–106, 2003.

http://www.dmtcs.org/volumes/abstracts/dm060108.abs.html

We solve the recursion $S_n = S_{n-1} - q^n S_{n-p}$, both, explicitly, and in the limit for $n\to\infty$, proving in this way a formula due to Merlini and Sprugnoli. It is also discussed how computer algebra could be applied.

[DMTCS-060109] Wei-Mei Chen, Hsien-Kuei Hwang, and Tsung-Hsi Tsai. Efficient maxima-finding algorithms for random planar samples. *Discrete Mathematics and Theoretical Computer Science*, 6(1):107–122, 2003.

http://www.dmtcs.org/volumes/abstracts/dm060109.abs.html

We collect major known algorithms in the literature for finding the maxima of multi-dimensional points and provide a simple classification. Several new algorithms are proposed. In particular, we give a new maxima-finding algorithm with expected complexity $n + O(\sqrt{n \log n})$ when the input is a sequence of points uniformly chosen at random from general planar regions. We also give a sequential algorithm, very efficient for practical purposes.

[DMTCS-060110] Selma Djelloul and Mekkia Kouider. Minimum survivable graphs with bounded distance increase. *Discrete Mathematics and Theoretical Computer Science*, 6(1):123–132, 2003.

http://www.dmtcs.org/volumes/abstracts/dm060110.abs.html

We study in graphs properties related to fault-tolerance in case a node fails. A graph G is k-self-repairing, where k is a non-negative integer, if after the removal of any vertex no distance in the surviving graph increases by more than k. In the design of interconnection networks such graphs guarantee good fault-tolerance properties. We give upper and lower bounds on the minimum number of edges of a k-self-repairing graph for prescribed k and n, where n is the order of the graph. We prove that the problem of finding, in a k-self-repairing graph, a spanning k-self-repairing subgraph of minimum size is NP-Hard.

[DMTCS-060111] Andreas Weiermann. An application of results by Hardy, Ramanujan and Karamata to Ackermannian functions. *Discrete Mathematics and Theoretical Computer Science*, 6(1):133–142, 2003.

http://www.dmtcs.org/volumes/abstracts/dm060111.abs.html

The Ackermann function is a fascinating and well studied paradigm for a function which eventually dominates all primitive recursive functions. By a classical result from the theory of recursive functions it is known that the Ackermann function can be defined by an unnested or descent recursion along the segment of ordinals below ω^ω (or equivalently along the order type of the polynomials under eventual domination). In this article we give a fine structure analysis of such a Ackermann type descent recursion in the case that the ordinals below ω^ω are represented via a Hardy Ramanujan style coding. This paper combines number-theoretic results by Hardy and Ramanujan, Karamata's celebrated Tauberian theorem and techniques from the theory of computability in a perhaps surprising way.

[DMTCS-060201] Narjes Berregeb, Riadh Robbana, and Ashish Tiwari. Towards automated proofs of observational properties. *Discrete Mathematics and Theoretical Computer Science*, 6(2):143–162, 2004.

http://www.dmtcs.org/volumes/abstracts/dm060201.abs.html

Observational theories are a generalization of first-order theories where two objects are observationally equal if they cannot be distinguished by experiments with observable results. Such experiments, called contexts, are usually infinite. Therfore, we consider a special finite set of contexts, called cover-contexts, "*covering*" all the observable contexts. Then, we show that to prove that two objects are observationally equal, it is sufficient to prove that they are equal (in the classical sense) under these cover-contexts. We give methods based on rewriting techniques, for constructing such cover-contexts for interesting classes of observational specifications.

[DMTCS-060202] Nathalie Caspard and Bernard Monjardet. Some lattices of closure systems on a finite set. *Discrete Mathematics and Theoretical Computer Science*, 6(2):163–190, 2004.

http://www.dmtcs.org/volumes/abstracts/dm060202.abs.html

In this paper we study two lattices of significant particular closure systems on a finite set, namely the union stable closure systems and the convex geometries. Using the notion of (admissible) quasi-closed set and of (deletable) closed set, we determine the covering relation $\prec$ of these lattices and the changes induced, for instance, on the irreducible elements when one goes from C to C' where C and C' are two such closure systems satisfying $C \prec C'$. We also do a systematic study of these lattices of closure systems, characterizing for instance their join-irreducible and their meet-irreducible elements.

[DMTCS-060203] Mireille Régnier and Alain Denise. Rare events and conditional events on random strings. *Discrete Mathematics and Theoretical Computer Science*, 6(2):191–214, 2004.

http://www.dmtcs.org/volumes/abstracts/dm060203.abs.html

Some strings -the texts- are assumed to be randomly generated, according to a probability model that is either a Bernoulli model or a Markov model. A rare event is the over or under-representation of a word or a set of words. The aim of this paper is twofold. First, a single word is given. One studies the tail distribution of the number of its occurrences. Sharp large deviation estimates are derived. Second, one assumes that a given word is overrepresented. The distribution of a second word is studied; formulae for the expectation and the variance are derived. In both cases, the formulae are accurate and actually computable. These results have applications in computational biology, where a genome is viewed as a text.

[DMTCS-060204] Vladimir E. Alekseev, Alastair Farrugia, and Vadim V. Lozin. New results on generalized graph coloring. *Discrete Mathematics and Theoretical Computer Science*, 6(2):215–222, 2004.

http://www.dmtcs.org/volumes/abstracts/dm060204.abs.html

For graph classes $\wp_1, ..., \wp_k$, Generalized Graph Coloring is the problem of deciding whether the vertex set of a given graph G can be partitioned into subsets $V_1, ..., V_k$ so that V_j induces a graph in the class $\wp_j$ $(j = 1, 2, ..., k)$. If $\wp_1 = ... = \wp_k$ is the class of edgeless graphs, then this problem coincides with the standard vertex k-COLORABILITY, which is known to be NP-complete for any $k \geq 3$. Recently, this result has been generalized by showing that if all $\wp_i$'s are additive hereditary, then the generalized graph coloring is NP-hard, with the only exception of bipartite graphs. Clearly, a similar result follows when all the $\wp_i$'s are co-additive.

[DMTCS-060205] Eric Babson and Victor Reiner. Coxeter-like complexes. *Discrete Mathematics and Theoretical Computer Science*, 6(2):223–252, 2004.

http://www.dmtcs.org/volumes/abstracts/dm060205.abs.html

Motivated by the Coxeter complex associated to a Coxeter system (W, S), we introduce a simplicial regular cell complex $\Delta(G, S)$ with a G-action associated to any pair (G, S) where G is a group and S is a finite set of generators for G which is minimal with respect to inclusion. We examine the topology of $\Delta(G, S)$, and in particular the representations of G on its homology groups. We look closely at the case of the symmetric group S_n minimally generated by (not necessarily adjacent) transpositions, and their type-selected subcomplexes. These include not only the Coxeter complexes of type A, but also the well-studied chessboard complexes.

[DMTCS-060206] Josef Pieprzyk and Xian-Mo Zhang. On cheating immune secret sharing. *Discrete Mathematics and Theoretical Computer Science*, 6(2):253–264, 2004.

http://www.dmtcs.org/volumes/abstracts/dm060206.abs.html

The paper addresses the cheating prevention in secret sharing. We consider secret sharing with binary shares. The secret also is binary. This model allows us to use results and constructions from the well developed theory of cryptographically strong boolean functions. In particular, we prove that for given secret sharing, the average cheating probability over all cheating vectors and all original vectors, i.e., $1/n2^n \sum_{c=1...n} \sum_{\alpha \in Vn} \rho_{c,\alpha}$, denoted by $\overline{\rho}$, satisfies $\overline{\rho} \geq \frac{1}{2}$, and the equality holds if and only if $\rho_{c,\alpha}$ satisfies $\rho_{c,\alpha} = \frac{1}{2}$ for every cheating vector δ_c and every original vector α. In this case the secret sharing is said to be cheating immune. We further establish a relationship between cheating-immune secret sharing and cryptographic criteria of boolean functions.This enables us to construct cheating-immune secret sharing.

[DMTCS-060207] Iiro Honkala, Tero Laihonen, and Sanna Ranto. On locating-dominating codes in binary Hamming spaces. *Discrete Mathematics and Theoretical Computer Science*, 6(2):265–282, 2004.

http://www.dmtcs.org/volumes/abstracts/dm060207.abs.html

Locating faulty processors in a multiprocessor system gives the motivation for locating-dominating codes. We consider these codes in binary hypercubes and generalize the concept for the situation in which we want to locate more than one malfunctioning processor.

[DMTCS-060208] Frédéric Chazal and Véronique Maume-Deschamps. Statistical properties of general Markov dynamical sources: applications to information theory. *Discrete Mathematics and Theoretical Computer Science*, 6(2):283–314, 2004.

http://www.dmtcs.org/volumes/abstracts/dm060208.abs.html

In *Dynamical sources in information theory: fundamental intervals and word prefixes*, B. Vallée studies statistical properties of words generated by dynamical sources. This is done using generalized Ruelle operators. The aim of this article is to generalize sources for which the results hold. First, we avoid the use of Grotendieck theory and Fredholm determinants, this allows dynamical sources that cannot be extended to a complex disk or that are not analytic. Second, we consider Markov sources: the language generated by the source over an alphabet $\mathbf{M}$ is not necessarily $\mathbf{M}^*$.

[DMTCS-060209] Karell Bertet and Mirabelle Nebut. Efficient algorithms on the family associated to an implicational system. *Discrete Mathematics and Theoretical Computer Science*, 6(2):315–338, 2004.

http://www.dmtcs.org/volumes/abstracts/dm060209.abs.html

An implication system (IS) on a finite set S is a set of rules called Σ-implications of the kind $A \rightarrow_\Sigma B$, with $A, B \subseteq S$. A subset $X \subseteq S$ satisfies $A \rightarrow_\Sigma B$ when "$A \subseteq X$ implies $B \subseteq X$" holds, so ISs can be used to describe constraints on sets of elements, such as dependency or causality. ISs are formally closely linked to the well known notions of closure operators and Moore families. This paper focuses on their algorithmic aspects. A number of problems issued from an IS Σ (e.g. is it minimal, is a given implication entailed by the system) can be reduced to the computation of closures $\phi_\Sigma(X)$, where ϕ_Σ is the closure operator associated to Σ. We propose a new approach to compute such closures, based on the characterization of the direct-optimal IS Σ_{do} which has the following properties:

1. it is equivalent to Σ
2. $\phi_{\Sigma_{do}}(X)$ (thus $\phi_\Sigma(X)$) can be computed by a single scanning of Σ_{do}-implications
3. it is of minimal size with respect to ISs satisfying 1. and 2.

We give algorithms that compute Σ_{do}, and from Σ_{do} closures $\phi_\Sigma(X)$ and the Moore family associated to ϕ_Σ.

[DMTCS-060210] Vida Dujmović and David R. Wood. On linear layouts of graphs. *Discrete Mathematics and Theoretical Computer Science*, 6(2):339–358, 2004.

http://www.dmtcs.org/volumes/abstracts/dm060210.abs.html

In a total order of the vertices of a graph, two edges with no endpoint in common can be *crossing*, *nested*, or *disjoint*. A k*-stack* (respectively, k*-queue*, k*-arch*) *layout* of a graph consists of a total order of the vertices, and a partition of the edges into k sets of pairwise non-crossing (non-nested, non-disjoint) edges. Motivated by numerous applications, stack layouts (also called *book embeddings*) and queue layouts are widely studied in the literature, while this is the first paper to investigate arch layouts.
Our main result is a characterisation of k-arch graphs as the *almost* $(k+1)$*-colourable* graphs; that is, the graphs G with a set S of at most k vertices, such that $G\ S$ is $(k+1)$-colourable.
In addition, we survey the following fundamental questions regarding each type of layout, and in the case of queue layouts, provide simple proofs of a number of existing results. How does one partition the edges given a fixed ordering of the vertices? What is the maximum number of edges in each type of layout? What is the maximum chromatic number of a graph admitting each type of layout? What is the computational complexity of recognising the graphs that admit each type of layout?
A comprehensive bibliography of all known references on these topics is included.

[DMTCS-060211] Rajendra M. Pawale. A note on t-designs with t intersection numbers. *Discrete Mathematics and Theoretical Computer Science*, 6(2):359–364, 2004.

http://www.dmtcs.org/volumes/abstracts/dm060211.abs.html

We discuss Ray-Chaudhari and Wilson inequality for a 0-design and give simple proof of the result '*For fixed block size k, there exist finitely many parametrically feasible t-designs with t intersection numbers and $\lambda > 1$*'.

[DMTCS-060212] Carsten Schneider. The summation package sigma: Underlying principles and a rhombus tiling application. *Discrete Mathematics and Theoretical Computer Science*, 6(2):365–386, 2004.

http://www.dmtcs.org/volumes/abstracts/dm060212.abs.html

We give an overview of how a huge class of multisum identities can be proven and discovered with the summation package Sigma implemented in the computer algebra system Mathematica. General principles of symbolic summation are discussed. We illustrate the usage of Sigma by showing how one can find and prove a multisum identity that arose in the enumeration of rhombus tilings of a symmetric hexagon. Whereas this identity has been derived alternatively with the help of highly involved transformations of special functions, our tools enable to find and prove this identity completely automatically with the computer.

[DMTCS-060213] Michael Drmota and Bernhard Gittenberger. The width of Galton-Watson trees conditioned by the size. *Discrete Mathematics and Theoretical Computer Science*, 6(2):387–400, 2004.

http://www.dmtcs.org/volumes/abstracts/dm060213.abs.html

It is proved that the moments of the width of Galton-Watson trees of size n and with offspring variance σ^2 are asymptotically given by $(\sigma\sqrt{n})^p m_p$ where m_p are the moments of the maximum of the local time of a standard scaled Brownian excursion. This is done by combining a weak limit theorem and a tightness estimate. The method is quite general and we state some further applications.

[DMTCS-060214] P. Mark Kayll. Well-spread sequences and edge-labellings with constant hamilton-weight. *Discrete Mathematics and Theoretical Computer Science*, 6(2):401–408, 2004.

http://www.dmtcs.org/volumes/abstracts/dm060214.abs.html

A sequence (a_i) of integers is *well-spread* if the sums $a_i + a_j$, for $i < j$, are all different. For a fixed positive integer r, let $W_r(N)$ denote the maximum integer n for which there exists a well-spread sequence $0 \leq a_1 < \ldots < a_n \leq N$ with $a_i \equiv a_j (bmod r)$ for all i, j. We give a new proof that $W_r(N) < (N/r)^{1/2} + O((N/r)^{1/4})$; our approach improves a bound of Ruzsa [*Acta.Arith.* **65** (1993), 259–283] by decreasing the implicit constant, essentially from 4 to $\sqrt{3}$. We apply this result to verify a conjecture of Jones et al. from [*Discuss. Math. Graph Theory* **23** (2003), 287–307]. The application concerns the growth-rate of the maximum label $\Lambda(n)$ in a 'most-efficient' metric, injective edge-labelling of K_n with the property that every Hamilton cycle has the same length; we prove that $2n^2 - O(n^{3/2}) < \Lambda(n) < 2n^2 + O(n^{61/40})$.

[DMTCS-060215] Wolfgang Steiner. The distribution of m-ary search trees generated by van der corput sequences. *Discrete Mathematics and Theoretical Computer Science*, 6(2):409–424, 2004.

http://www.dmtcs.org/volumes/abstracts/dm060215.abs.html

We study the structure of m-ary search trees generated by the van der Corput sequences. The height of the tree is calculated and a generating function approach shows that the distribution of the depths of the nodes is asymptotically normal. Additionally a local limit theorem is derived.

[DMTCS-060216] Vincent Puyhaubert. Generating functions and the satisfiability threshold. *Discrete Mathematics and Theoretical Computer Science*, 6(2):425–436, 2004.

http://www.dmtcs.org/volumes/abstracts/dm060216.abs.html

The $3-SAT$ problem consists in determining if a boolean formula with 3 literals per clause is satisfiable. When the ratio between the number of clauses and the number of variables increases, a threshold phenomenon is observed: the probability of satisfiability appears to decrease sharply from 1 to 0 in the neighbourghood of a threshold value, conjectured to be close to 4.25. Although the threshold has been proved to exist for the $2-SAT$ formulæ and for closely related problems like $3-XORSAT$, there is still no proof for the $3-sat$ problem. Recent works have provided so far upper and lower bounds for the threshold's potential location. We present here a unified approach to upper bounds that is based on urn models, generating functions, and saddle-point bounds. In this way, we re-derive some of the most significant upper bounds known in a simple and uniform manner.

[DMTCS-060217] Alois Panholzer and Helmut Prodinger. Analysis of some statistics for increasing tree families. *Discrete Mathematics and Theoretical Computer Science*, 6(2):437–460, 2004.

http://www.dmtcs.org/volumes/abstracts/dm060217.abs.html

This paper deals with statistics concerning distances between randomly chosen nodes in varieties of increasing trees. Increasing trees are labelled rooted trees where labels along any branch from the root go in increasing order. Many mportant tree families that have applications in computer science or are used as probabilistic models in various applications, like *recursive trees, heap-ordered trees* or *binary increasing trees* (isomorphic to binary search trees) are members of this variety of trees. We consider the parameters *depth* of a randomly chosen node, *distance* between two randomly chosen nodes, and the generalisations where *p* nodes are randomly chosen Under the restriction that the node-degrees are bounded, we can prove that all these parameters converge in law to the Normal distribution. This extends results obtained earlier for binary search trees and heap-ordered trees to a much larger class of structures.

[DMTCS-060218] Toufik Mansour. On an open problem of green and losonczy: exact enumeration of freely braided permutations. *Discrete Mathematics and Theoretical Computer Science*, 6(2):461–470, 2004.

http://www.dmtcs.org/volumes/abstracts/dm060218.abs.html

Recently, Green and Losonczy ¡cite¿GL1,GL2¡/cite¿ introduced *freely braided* permutation as a special class of restricted permutations has arisen in representation theory. The freely braided permutations were introduced and studied as the upper bound for the number of commutation classes of reduced expressions for an element of a simply laced Coxeter group is achieved if and only if when the element is freely braided. In this paper, we prove that the generating function for the number of freely braided permutations in S_n is given by
$< frac > (1-3x-2x^2+(1+x)\sqrt{1-4x})/(1-4x-x^2+(1-x^2)\sqrt{1-4x}) < /frac > .$

[DMTCS-060219] Josef Pieprzyk and Xian-Mo Zhang. Characterisations of ideal threshold schemes. *Discrete Mathematics and Theoretical Computer Science*, 6(2):471–482, 2004.

http://www.dmtcs.org/volumes/abstracts/dm060219.abs.html

We characterise ideal threshold schemes from different approaches. Since the characteristic properties are independent to particular descriptions of threshold schemes all ideal threshold schemes can be examined by new points of view and new results on ideal threshold schemes can be discovered.

[DMTCS-060220] Hon-Chan Chen. Optimal sequential and parallel algorithms for cut vertices and bridges on trapezoid graphs. *Discrete Mathematics and Theoretical Computer Science*, 6(2):483–496, 2004.

http://www.dmtcs.org/volumes/abstracts/dm060220.abs.html

Let G be a graph. A component of G is a maximal connected subgraph in G. A vertex v is a cut vertex of G if k(G-v) ¿ k(G), where k(G) is the number of components in G. Similarly, an edge e is a bridge of G if k(G-e) ¿ k(G). In this paper, we will propose new O(n) algorithms for finding cut vertices and bridges of a trapezoid graph, assuming the trapezoid diagram is given. Our algorithms can be easily parallelized on the EREW PRAM computational model so that cut vertices and bridges can be found in O(log n) time by using O(n / log n) processors.

[DMTCS-060221] Vida Dujmovi{ć}, Attila P{ó}r, and David R. Wood. Track layouts of graphs. *Discrete Mathematics and Theoretical Computer Science*, 6(2):497–522, 2004.

http://www.dmtcs.org/volumes/abstracts/dm060221.abs.html

A (k, t)-*track layout* of a graph G consists of a (proper) vertex t-colouring of G, a total order of each vertex colour class, and a (non-proper) edge k-colouring such that between each pair of colour classes no two monochromatic edges cross. This structure has recently arisen in the study of three-dimensional graph drawings. This paper presents the beginnings of a theory of track layouts. First we determine the maximum number of edges in a (k, t)-track layout, and show how to colour the edges given fixed linear orderings of the vertex colour classes. We then describe methods for the manipulation of track layouts. For example, we show how to decrease the number of edge colours in a track layout at the expense of increasing the number of tracks, and vice versa. We then study the relationship between track layouts and other models of graph layout, namely stack and queue layouts, and geometric thickness. One of our principle results is that the queue-number and track-number of a graph are tied, in the sense that one is bounded by a function of the other. As corollaries we prove that acyclic chromatic number is bounded by both queue-number and stack-number. Finally we consider track layouts of planar graphs. While it is an open problem whether planar graphs have bounded track-number, we prove bounds on the track-number of outerplanar graphs, and give the best known lower bound on the track-number of planar graphs.

[DMTCS-060222] Po-Shen Loh and Leonard J. Schulman. Improved expansion of random cayley graphs. *Discrete Mathematics and Theoretical Computer Science*, 6(2):523–528, 2004.

http://www.dmtcs.org/volumes/abstracts/dm060222.abs.html

In ¡cite¿Random Cayley Graphs and Expanders¡/cite¿, N. Alon and Y. Roichman proved that for every $\epsilon > 0$ there is a finite $c(\epsilon)$ such that for any sufficiently large group G, the expected value of the second largest (in absolute value) eigenvalue of the normalized adjacency matrix of the Cayley graph with respect to $c(\epsilon)log|G|$ random elements is less than ϵ. We reduce the number of elements to $c(\epsilon)logD(G)$ (for the same c), where $D(G)$ is the sum of the dimensions of the irreducible representations of G. In sufficiently non-abelian families of groups (as measured by these dimensions), $logD(G)$ is asymptotically $(1/2)log|G|$. As is well known, a small eigenvalue implies large graph expansion (and conversely); see ¡cite¿Tanner84¡/cite¿ and ¡cite¿AlonMilman84-2,AlonMilman84-1¡/cite¿. For any specified eigenvalue or expansion, therefore, random Cayley graphs (of sufficiently non-abelian groups) require only half as many edges as was previously known.

[DMTCS-070101] Arthur Holshouser and Harold Reiter. Two pile move-size dynamic nim. *Discrete Mathematics and Theoretical Computer Science*, 7(1):1–10, 2005.

http://www.dmtcs.org/volumes/abstracts/dm070101.abs.html

The purpose of this paper is to solve a special class of combinational games consisting of two-pile counter pickup games for which the maximum number of counters that can be removed on each successive move changes during the play of the games. Two players alternate moving. Each player in his turn first chooses one of the piles, and his choice of piles can change from move to move. He then removes counters from this chosen pile. A function $f :< bf > Z^+ < /bf > \rightarrow < bf > Z^+ < /bf >$ is given which determines the maximum size of the next move in terms of the current move size. The game ends as soon as one of the two piles is empty, and the winner is the last player to move in the game. The games for which $f(k) = k$, $f(k) = 2k$, and $f(k) = 3k$ use the same formula for computing the smallest winning move size. Here we find all the functions f for which this formula works, and we also give the winning strategy for each function. See ¡cite¿Holshouser, A, James Rudzinski and Harold Reiter: Dynamic One-Pile Nim¡/cite¿ for a discussion of the single pile game.

[DMTCS-070102] Mohamud Mohammed. Infinite families of accelerated series for some classical constants by the markov-wz method. *Discrete Mathematics and Theoretical Computer Science*, 7(1):11–24, 2005.

http://www.dmtcs.org/volumes/abstracts/dm070102.abs.html

In this article we show the Markov-WZ Method in action as it finds rapidly converging series representations for a given hypergeometric series. We demonstrate the method by finding new representations for $< displaystyle > log(2), \zeta(2) < /displaystyle >$ and $\zeta(3)$.

[DMTCS-070103] L. Sunil Chandran, Vadim V. Lozin, and C.R. Subramanian. Graphs of low chordality. *Discrete Mathematics and Theoretical Computer Science*, 7(1):25–36, 2005.

http://www.dmtcs.org/volumes/abstracts/dm070103.abs.html

The chordality of a graph with at least one cycle is the length of the longest induced cycle in it. The odd (even) chordality is defined to be the length of the longest induced odd (even) cycle in it. Chordal graphs have chordality at most 3. We show that co-circular-arc graphs and co-circle graphs have even chordality at most 4. We also identify few other classes of graphs having bounded (by a constant) chordality values.

[DMTCS-070104] David R. Wood. Acyclic, star and oriented colourings of graph subdivisions. *Discrete Mathematics and Theoretical Computer Science*, 7(1):37–50, 2005.

http://www.dmtcs.org/volumes/abstracts/dm070104.abs.html

Let G be a graph with chromatic number $\chi(G)$. A vertex colouring of G is *acyclic* if each bichromatic subgraph is a forest. A *star colouring* of G is an acyclic colouring in which each bichromatic subgraph is a star forest. Let $\chi_a(G)$ and $\chi_s(G)$ denote the acyclic and star chromatic numbers of G. This paper investigates acyclic and star colourings of subdivisions. Let G' be the graph obtained from G by subdividing each edge once. We prove that acyclic (respectively, star) colourings of G' correspond to vertex partitions of G in which each subgraph has small arboricity (chromatic index). It follows that $\chi_a(G')$, $\chi_s(G')$ and $\chi(G)$ are tied, in the sense that each is bounded by a function of the other. Moreover the binding functions that we establish are all tight. The *oriented chromatic number* $\chi^{\rightarrow}(G)$ of an (undirected) graph G is the maximum, taken over all orientations D of G, of the minimum number of colours in a vertex colouring of D such that between any two colour classes, all edges have the same direction. We prove that $\chi^{\rightarrow}(G') = \chi(G)$ whenever $\chi(G) \geq 9$.

[DMTCS-070105] Grard H. E. Duchamp, Hatem Hadj Kacem, and Eric Laugerotte. Algebraic elimination of ϵ-transitions. *Discrete Mathematics and Theoretical Computer Science*, 7(1):51–70, 2005.

http://www.dmtcs.org/volumes/abstracts/dm070105.abs.html

We here describe a method of removing the ϵ-transitions of a weighted automaton. The existence of a solution for this removal depends on the existence of the star of a single matrix which, in turn, is based on the computation of the stars of scalars in the ground semiring. We discuss two aspects of the star problem (by infinite sums and by equations) and give an algorithm to suppress the ϵ-transitions and preserve the behaviour. Running complexities are computed.

[DMTCS-070106] M. D. Atkinson. Some equinumerous pattern-avoiding classes of permutations. *Discrete Mathematics and Theoretical Computer Science*, 7(1):71–74, 2005.

http://www.dmtcs.org/volumes/abstracts/dm070106.abs.html

Suppose that p, q, r, s are non-negative integers with $m = p + q + r + s$. The class $X(p, q, r, s)$ of permutations that contain no pattern of the form $\alpha\beta\gamma$ where $|\alpha| = r, |\gamma| = s$ and β is any arrangement of $\{1, 2, \ldots, p\} \cup \{m - q + 1, m - q + 2, \ldots, m\}$ is considered. A recurrence relation to enumerate the permutations of $X(p, q, r, s)$ is established. The method of proof also shows that $X(p, q, r, s) = X(p, q, 1, 0)X(1, 0, r, s)$ in the sense of permutational composition.
2000 MATHEMATICS SUBJECT CLASSIFICATION: 05A05

[DMTCS-070107] Chunhui Lai. An extremal problem on potentially $K_{p,1,1}$-graphic sequences. *Discrete Mathematics and Theoretical Computer Science*, 7(1):75–80, 2005.

http://www.dmtcs.org/volumes/abstracts/dm070107.abs.html

A sequence S is potentially $K_{p,1,1}$ graphical if it has a realization containing a $K_{p,1,1}$ as a subgraph, where $K_{p,1,1}$ is a complete 3-partite graph with partition sizes $p, 1, 1$. Let $\sigma(K_{p,1,1}, n)$ denote the smallest degree sum such that every n-term graphical sequence S with $\sigma(S) \geq \sigma(K_{p,1,1}, n)$ is potentially $K_{p,1,1}$ graphical. In this paper, we prove that $\sigma(K_{p,1,1}, n) \geq 2[((p+1)(n-1)+2)/2]$ for $n \geq p+2$. We conjecture that equality holds for $n \geq 2p+4$. We prove that this conjecture is true for $p = 3$. AMS Subject Classifications: 05C07, 05C35

[DMTCS-070108] Shunji Ito and Hiromi Ei. Tilings from some non-irreducible, pisot substitutions. *Discrete Mathematics and Theoretical Computer Science*, 7(1):81–122, 2005.

http://www.dmtcs.org/volumes/abstracts/dm070108.abs.html

A generating method of self-affine tilings for Pisot, unimodular, irreducible substitutions, as well as the fact that the associated substitution dynamical systems are isomorphic to rotations on the torus are established in ¡cite¿P. Arnoux and S. Ito¡/cite¿. The aim of this paper is to extend these facts in the case where the characteristic polynomial of a substitution is non-irreducible for a special class of substitutions on five letters. Finally we show that the substitution dynamical systems for this class are isomorphic to induced transformations of rotations on the torus.

[DMTCS-070109] Ana M. Breda and Altino F. Santos. Dihedral f-tilings of the sphere by rhombi and triangles. *Discrete Mathematics and Theoretical Computer Science*, 7(1):123–140, 2005.

http://www.dmtcs.org/volumes/abstracts/dm070109.abs.html

We classify, up to an isomorphism, the class of all dihedral f-tilings of S^2, whose prototiles are a spherical triangle and a spherical rhombus. The equiangular case was considered and classified in ¡cite¿Ana M. Breda and Altino F. Santos, Dihedral f-tilings of the sphere by spherical triangles and equiangular well-centered quadrangles¡/cite¿. Here we complete the classification considering the case of non-equiangular rhombi.

[DMTCS-070110] N. Abbas, J. Culberson, and L. Stewart. Recognizing maximal unfrozen graphs with respect to independent sets is co-np-complete. *Discrete Mathematics and Theoretical Computer Science*, 7(1):141–154, 2005.

http://www.dmtcs.org/volumes/abstracts/dm070110.abs.html

A graph is unfrozen with respect to k independent set if it has an independent set of size k after the addition of any edge. The problem of recognizing such graphs is known to be NP-complete. A graph is maximal if the addition of one edge means it is no longer unfrozen. We designate the problem of recognizing maximal unfrozen graphs as MAX($U(k$-SET)) and show that this problem is CO-NP-complete. This partially fills a gap in known complexity cases of maximal NP-complete problems, and raises some interesting open conjectures discussed in the conclusion.

[DMTCS-070111] Vida Dujmović and David R. Wood. Stacks, queues and tracks: Layouts of graph subdivisions. *Discrete Mathematics and Theoretical Computer Science*, 7(1):155–202, 2005.

http://www.dmtcs.org/volumes/abstracts/dm070111.abs.html

A k-*stack layout* (respectively, k-*queuelayout*) of a graph consists of a total order of the vertices, and a partition of the edges into k sets of non-crossing (non-nested) edges with respect to the vertex ordering. A k-*track layout* of a graph consists of a vertex k-colouring, and a total order of each vertex colour class, such that between each pair of colour classes no two edges cross. The *stack-number* (respectively, *queue-number*, *track-number*) of a graph G, denoted by $sn(G)$ ($qn(G)$, $tn(G)$), is the minimum k such that G has a k-stack (k-queue, k-track) layout.
This paper studies stack, queue, and track layouts of graph subdivisions. It is known that every graph has a 3-stack subdivision. The best known upper bound on the number of division vertices per edge in a 3-stack subdivision of an n-vertex graph G is improved from $O(logn)$ to $O(logmin\{sn(G), qn(G)\})$. This result reduces the question of whether queue-number is bounded by stack-number to whether 3-stack graphs have bounded queue number.
It is proved that every graph has a 2-queue subdivision, a 4-track subdivision, and a mixed 1-stack 1-queue subdivision. All these values are optimal for every non-planar graph. In addition, we characterise those graphs with k-stack, k-queue, and k-track subdivisions, for all values of k. The number of division vertices per edge in the case of 2-queue and 4-track subdivisions, namely $O(logqn(G))$, is optimal to within a constant factor, for every graph G.
Applications to 3D polyline grid drawings are presented. For example, it is proved that every graph G has a 3D polyline grid drawing with the vertices on a rectangular prism, and with $O(logqn(G))$ bends per edge. Finally, we establish a tight relationship between queue layouts and so-called 2-track thickness of bipartite graphs.

[DMTCS-070112] Mohammad Hosseini Dolama and Eric Sopena. On the maximum average degree and the incidence chromatic number of a graph. *Discrete Mathematics and Theoretical Computer Science*, 7(1):203–216, 2005.

http://www.dmtcs.org/volumes/abstracts/dm070112.abs.html

We prove that the incidence chromatic number of every 3-degenerated graph G is at most $\Delta(G) + 4$. It is known that the incidence chromatic number of every graph G with maximum average degree $mad(G) < 3$ is at most $\Delta(G) + 3$. We show that when $\Delta(G) \geq 5$, this bound may be decreased to $\Delta(G) + 2$. Moreover, we show that for every graph G with $mad(G) < 22/9$ (resp. with $mad(G) < 16/7$ and $\Delta(G) \geq 4$), this bound may be decreased to $\Delta(G) + 2$ (resp. to $\Delta(G) + 1$).

[DMTCS-AA0101] Nicolas Destainville. Mixing times of plane random rhombus tilings. In Robert Cori, Jacques Mazoyer, Michel Morvan, and Rémy Mosseri, editors, *Discrete Models: Combinatorics, Computation, and Geometry, DM-CCG 2001*, volume AA of *DMTCS Proceedings*, pages 1–22. Discrete Mathematics and Theoretical Computer Science, 2001.

http://www.dmtcs.org/proceedings/html/dmAA0101.abs.html

We address the question of single flip discrete dynamics in sets of two-dimensional random rhombus tilings with fixed polygonal boundaries. Single flips are local rearrangements of tiles which enable to sample the configuration sets of tilings via Markov chains. We determine the convergence rates of these dynamical processes towards the statistical equilibrium distributions and we demonstrate that the dynamics are rapidly mixing: the ergodic times are polynomial in the number of tiles up to logarithmic corrections. We use an inherent symmetry of tiling sets which enables to decompose them into smaller subsets where a technique from probability theory, the so-called coupling technique, can be applied. We also point out an interesting occurrence in this work of extreme-value statistics, namely Gumbel distributions.

[DMTCS-AA0102] Joakim Linde, Cristopher Moore, and Mats G. Nordahl. An n-dimensional generalization of the rhombus tiling. In Robert Cori, Jacques Mazoyer, Michel Morvan, and Rémy Mosseri, editors, *Discrete Models: Combinatorics, Computation, and Geometry, DM-CCG 2001*, volume AA of *DMTCS Proceedings*, pages 23–42. Discrete Mathematics and Theoretical Computer Science, 2001.

http://www.dmtcs.org/proceedings/html/dmAA0102.abs.html

Several classic tilings, including rhombuses and dominoes, possess height functions which allow us to 1) prove ergodicity and polynomial mixing times for Markov chains based on local moves, 2) use coupling from the past to sample perfectly random tilings, 3) map the statistics of random tilings at large scales to physical models of random surfaces, and and 4) are related to the "arctic circle" phenomenon. However, few examples are known for which this approach works in three or more dimensions. Here we show that the rhombus tiling can be generalized to n-dimensional tiles for any $n \geq 3$. For each n, we show that a certain local move is ergodic, and conjecture that it has a mixing time of $O(L^{(n+2)}logL)$ on regions of size L. For $n = 3$, the tiles are rhombohedra, and the local move consists of switching between two tilings of a rhombic dodecahedron. We use coupling from the past to sample random tilings of a large rhombic dodecahedron, and show that arctic regions exist in which the tiling is frozen into a fixed state. However, unlike the two-dimensional case in which the arctic region is an inscribed circle, here it seems to be octahedral. In addition, height fluctuations between the boundary of the region and the center appear to be constant rather than growing logarithmically. We conjecture that this is because the physics of the model is in a "smooth" phase where it is rigid at large scales, rather than a "rough" phase in which it is elastic.

[DMTCS-AA0103] James Propp. The many faces of alternating-sign matrices. In Robert Cori, Jacques Mazoyer, Michel Morvan, and Rémy Mosseri, editors, *Discrete Models: Combinatorics, Computation, and Geometry, DM-CCG 2001*, volume AA of *DMTCS Proceedings*, pages 43–58. Discrete Mathematics and Theoretical Computer Science, 2001.

http://www.dmtcs.org/proceedings/html/dmAA0103.abs.html

I give a survey of different combinatorial forms of alternating-sign matrices, starting with the original form introduced by Mills, Robbins and Rumsey as well as corner-sum matrices, height-function matrices, three-colorings, monotone triangles, tetrahedral order ideals, square ice, gasket-and-basket tilings and full packings of loops.

[DMTCS-AA0104] Pierre Arnoux, Valérie Berthé, Hiromi Ei, and Shunji Ito. Tilings, quasicrystals, discrete planes, generalized substitutions, and multidimensional continued fractions. In

Robert Cori, Jacques Mazoyer, Michel Morvan, and Rémy Mosseri, editors, *Discrete Models: Combinatorics, Computation, and Geometry, DM-CCG 2001*, volume AA of *DMTCS Proceedings*, pages 59–78. Discrete Mathematics and Theoretical Computer Science, 2001.

http://www.dmtcs.org/proceedings/html/dmAA0104.abs.html

The aim of this paper is to give an overview of recent results about tilings, discrete approximations of lines and planes, and Markov partitions for toral automorphisms. The main tool is a generalization of the notion of substitution. The simplest examples which correspond to algebraic parameters, are related to the iteration of one substitution, but we show that it is possible to treat arbitrary irrational examples by using multidimensional continued fractions. We give some non-trivial applications to Diophantine approximation, numeration systems and tilings, and we expose the main unsolved questions.

[DMTCS-AA0105] André Barbé and Fritz von Haeseler. Periodic patterns in orbits of certain linear cellular automata. In Robert Cori, Jacques Mazoyer, Michel Morvan, and Rémy Mosseri, editors, *Discrete Models: Combinatorics, Computation, and Geometry, DM-CCG 2001*, volume AA of *DMTCS Proceedings*, pages 79–94. Discrete Mathematics and Theoretical Computer Science, 2001.

http://www.dmtcs.org/proceedings/html/dmAA0105.abs.html

We discuss certain linear cellular automata whose cells take values in a finite field. We investigate the periodic behavior of the verticals of an orbit of the cellular automaton and establish that there exists, depending on the characteristic of the field, a universal behavior for the evolution of periodic verticals.

[DMTCS-AA0106] Christopher L. Barrett, Harry B. Hunt, III, Madhav V. Marathe, S. S. Ravi, Daniel J. Rosenkrantz, Richard E. Stearns, and Predrag T. Tosic. Gardens of eden and fixed points in sequential dynamical systems. In Robert Cori, Jacques Mazoyer, Michel Morvan, and Rémy Mosseri, editors, *Discrete Models: Combinatorics, Computation, and Geometry, DM-CCG 2001*, volume AA of *DMTCS Proceedings*, pages 95–110. Discrete Mathematics and Theoretical Computer Science, 2001.

http://www.dmtcs.org/proceedings/html/dmAA0106.abs.html

A class of finite discrete dynamical systems, called **Sequential Dynamical Systems** (SDSs), was proposed in [BMR99,BR99] as an abstract model of computer simulations. Here, we address some questions concerning two special types of the SDS configurations, namely Garden of Eden and Fixed Point configurations. A configuration C of an SDS is a Garden of Eden (GE) configuration if it cannot be reached from any configuration. A necessary and sufficient condition for the non-existence of GE configurations in SDSs whose state values are from a finite domain was provided in [MR00]. We show this condition is sufficient but not necessary for SDSs whose state values are drawn from an infinite domain. We also present results that relate the existence of GE configurations to other properties of an SDS. A configuration C of an SDS is a fixed point if the transition out of C is to C itself. The FIXED POINT EXISTENCE (or FPE) problem is to determine whether a given SDS has a fixed point. We show that the FPE problem is **NP**-complete even for some simple classes of SDSs (e.g., SDSs in which each local transition function is from the set {NAND, XNOR}). We also identify several classes of SDSs (e.g., SDSs with linear or monotone local transition functions) for which the FPE problem can be solved efficiently.

[DMTCS-AA0107] Sergei Bespamyatnikh. Enumerating triangulations of convex polytopes. In Robert Cori, Jacques Mazoyer, Michel Morvan, and Rémy Mosseri, editors, *Discrete Models: Combinatorics, Computation, and Geometry, DM-CCG 2001*, volume AA of *DMTCS Proceedings*, pages 111–122. Discrete Mathematics and Theoretical Computer Science, 2001.

http://www.dmtcs.org/proceedings/html/dmAA0107.abs.html

A triangulation of a finite point set A in R^d is a geometric simplicial complex which covers the convex hull of A and whose vertices are points of A. We study the graph of triangulations whose vertices represent the triangulations and whose edges represent geometric bistellar flips. The main result of this paper is that the graph of triangulations in three dimensions is connected when the points of A are in convex position. We introduce a tree of triangulations and present an algorithm for enumerating triangulations in $O(loglogn)$ time per triangulation.

[DMTCS-AA0108] François Boulier, Florent Hivert, Daniel Krob, and Jean-Christophe Novelli. Pseudo-permutations II: Geometry and representation theory. In Robert Cori, Jacques Mazoyer, Michel Morvan, and Rémy Mosseri, editors, *Discrete Models: Combinatorics, Computation, and Geometry, DM-CCG 2001*, volume AA of *DMTCS Proceedings*, pages 123–132. Discrete Mathematics and Theoretical Computer Science, 2001.

http://www.dmtcs.org/proceedings/html/dmAA0108.abs.html

In this paper, we provide the second part of the study of the pseudo-permutations. We first derive a complete analysis of the pseudo-permutations, based on hyperplane arrangements, generalizing the usual way of translating the permutations. We then study the module of the pseudo-permutations over the symmetric group and provide the characteristics of this action.

[DMTCS-AA0109] Alberto Del Lungo, Massimo Mirolli, Renzo Pinzani, and Simone Rinaldi. A bijection for directed-convex polyominoes. In Robert Cori, Jacques Mazoyer, Michel Morvan, and Rémy Mosseri, editors, *Discrete Models: Combinatorics, Computation, and Geometry, DM-CCG 2001*, volume AA of *DMTCS Proceedings*, pages 133–144. Discrete Mathematics and Theoretical Computer Science, 2001.

http://www.dmtcs.org/proceedings/html/dmAA0109.abs.html

In this paper we consider two classes of lattice paths on the plane which use *north*, *east*, *south*, and *west* unitary steps, beginning and ending at $(0, 0)$. We enumerate them according to the number of steps by means of bijective arguments; in particular, we apply the cycle lemma. Then, using these results, we provide a bijective proof for the number of directed-convex polyominoes having a fixed number of rows and columns.

[DMTCS-AA0110] Jérôme Durand-Lose. Representing reversible cellular automata with reversible block cellular automata. In Robert Cori, Jacques Mazoyer, Michel Morvan, and Rémy Mosseri, editors, *Discrete Models: Combinatorics, Computation, and Geometry, DM-CCG 2001*, volume AA of *DMTCS Proceedings*, pages 145–154. Discrete Mathematics and Theoretical Computer Science, 2001.

http://www.dmtcs.org/proceedings/html/dmAA0110.abs.html

Cellular automata are mappings over infinite lattices such that each cell is updated according to the states around it and a unique local function. Block permutations are mappings that generalize a given permutation of blocks (finite arrays of fixed size) to a given partition of the lattice in blocks. We prove that any d-dimensional reversible cellular automaton can be exp ressed as the composition of d+1 block permutations. We built a simulation in linear time of reversible cellular automata by reversible block cellular automata (also known as partitioning CA and CA with the Margolus neighborhood) which is valid for both finite and infinite configurations. This proves a 1990 conjecture by Toffoli and Margolus *Physica D* 45 improved by Kari in 1996 *Mathematical System Theory* 29).

[DMTCS-AA0111] M. Reza Emamy-Khansary and Martin Ziegler. New bounds for hypercube slicing numbers. In Robert Cori, Jacques Mazoyer, Michel Morvan, and Rémy Mosseri, editors, *Discrete Models: Combinatorics, Computation, and Geometry, DM-CCG 2001*, volume AA of *DMTCS Proceedings*, pages 155–164. Discrete Mathematics and Theoretical Computer Science, 2001.

http://www.dmtcs.org/proceedings/html/dmAA0111.abs.html

What is the maximum number of edges of the d-dimensional hypercube, denoted by $S(d, k)$, that can be sliced by k hyperplanes? This question on combinatorial properties of Euclidean geometry arising from linear separability considerations in the theory of Perceptrons has become an issue on its own. We use computational and combinatorial methods to obtain new bounds for $S(d, k)$, $d \leq 8$. These strengthen earlier results on hypercube cut numbers.

[DMTCS-AA0112] Robert Erra, Nik Lygeros, and Nigel Stewart. On minimal strings containing the elements of S_n by decimation. In Robert Cori, Jacques Mazoyer, Michel Morvan, and Rémy Mosseri, editors, *Discrete Models: Combinatorics, Computation, and Geometry, DM-CCG 2001*, volume AA of *DMTCS Proceedings*, pages 165–176. Discrete Mathematics and Theoretical Computer Science, 2001.

http://www.dmtcs.org/proceedings/html/dmAA0112.abs.html

The *permutations by decimation* problem is thought to be applicable to computer graphics, and raises interesting theoretical questions in combinatory theory. We present the results of some theoretical and practical investigation into this problem. We show that sequences of this form are $O(n^2)$ in length, but finding optimal solutions can be difficult.

[DMTCS-AA0113] Kellie M. Evans. Larger than life: Digital creatures in a family of two-dimensional cellular automata. In Robert Cori, Jacques Mazoyer, Michel Morvan, and Rémy Mosseri, editors, *Discrete Models: Combinatorics, Computation, and Geometry, DM-CCG 2001*, volume AA of *DMTCS Proceedings*, pages 177–192. Discrete Mathematics and Theoretical Computer Science, 2001.

http://www.dmtcs.org/proceedings/html/dmAA0113.abs.html

We introduce the Larger than Life family of two-dimensional two-state cellular automata that generalize certain nearest neighbor outer totalistic cellular automaton rules to large neighborhoods. We describe linear and quadratic rescalings of John Conway's celebrated Game of Life to these large neighborhood cellular automaton rules and present corresponding generalizations of Life's famous gliders and spaceships. We show that, as is becoming well known for nearest neighbor cellular automaton rules, these "digital creatures" are ubiquitous for certain parameter values.

[DMTCS-AA0114] Travis Herbranson and Don Rawlings. A sequential search distribution: Proofreading, russian roulette, and the incomplete q-eulerian polynomials. In Robert Cori, Jacques Mazoyer, Michel Morvan, and Rémy Mosseri, editors, *Discrete Models: Combinatorics, Computation, and Geometry, DM-CCG 2001*, volume AA of *DMTCS Proceedings*, pages 193–202. Discrete Mathematics and Theoretical Computer Science, 2001.

http://www.dmtcs.org/proceedings/html/dmAA0114.abs.html

The distribution for the number of searches needed to find k of n lost objects is expressed in terms of a refinement of the q-Eulerian polynomials, for which formulae are developed involving homogeneous symmetric polynomials. In the case when $k = n$ and the find probability remains constant, relatively simple and efficient formulas are obtained. From our main theorem, we further (1) deduce the inverse absorption distribution and (2) determine the expected number of times the survivor pulls the trigger in an n-player game of Russian roulette.

[DMTCS-AA0115] Daniel Krob and Ekaterina A. Vassilieva. Performance evaluation of demodulation methods: a combinatorial approach. In Robert Cori, Jacques Mazoyer, Michel Morvan, and Rémy Mosseri, editors, *Discrete Models: Combinatorics, Computation, and Geometry, DM-CCG 2001*, volume AA of *DMTCS Proceedings*, pages 203–214. Discrete Mathematics and Theoretical Computer Science, 2001.

http://www.dmtcs.org/proceedings/html/dmAA0115.abs.html

This paper provides a combinatorial approach for analyzing the performance of demodulation methods used in GSM. We also show how to obtain combinatorially a nice specialization of an important performance evaluation formula, using its connection with a classical bijection of Knuth between pairs of Young tableaux and $\{0, 1\}$-matrices.

[DMTCS-AA0116] Matthieu Latapy. Partitions of an integer into powers. In Robert Cori, Jacques Mazoyer, Michel Morvan, and Rémy Mosseri, editors, *Discrete Models: Combinatorics, Computation, and Geometry, DM-CCG 2001*, volume AA of *DMTCS Proceedings*, pages 215–228. Discrete Mathematics and Theoretical Computer Science, 2001.

http://www.dmtcs.org/proceedings/html/dmAA0116.abs.html

In this paper, we use a simple discrete dynamical model to study partitions of integers into powers of another integer. We extend and generalize some known results about their enumeration and counting, and we give new structural results. In particular, we show that the set of these partitions can be ordered in a natural way which gives the distributive lattice structure to this set. We also give a tree structure which allow efficient and simple enumeration of the partitions of an integer.

[DMTCS-AA0117] Clémence Magnien, Ha Duong Phan, and Laurent Vuillon. Characterization of lattices induced by (extended) chip firing games. In Robert Cori, Jacques Mazoyer, Michel Morvan, and Rémy Mosseri, editors, *Discrete Models: Combinatorics, Computation, and Geometry, DM-CCG 2001*, volume AA of *DMTCS Proceedings*, pages 229–244. Discrete Mathematics and Theoretical Computer Science, 2001.

http://www.dmtcs.org/proceedings/html/dmAA0117.abs.html

The Chip Firing Game (CFG) is a discrete dynamical model used in physics, computer science and economics. It is known that the set of configurations reachable from an initial configuration (this set is called the *configuration space*) can be ordered as a lattice. We first present a structural result about this model, which allows us to introduce some useful tools for describing those lattices. Then we establish that the class of lattices that are the configuration space of a CFG is strictly between the class of distributive lattices and the class of upper locally distributive (or ULD) lattices. Finally we propose an extension of the model, the *coloured* Chip Firing Game, which generates exactly the class of ULD lattices.

[DMTCS-AA0118] Criel Merino. The chip firing game and matroid complexes. In Robert Cori, Jacques Mazoyer, Michel Morvan, and Rémy Mosseri, editors, *Discrete Models: Combinatorics, Computation, and Geometry, DM-CCG 2001*, volume AA of *DMTCS Proceedings*, pages 245–256. Discrete Mathematics and Theoretical Computer Science, 2001.

http://www.dmtcs.org/proceedings/html/dmAA0118.abs.html

In this paper we construct from a cographic matroid M, a pure multicomplex whose degree sequence is the h–vector of the the matroid complex of M. This result proves a conjecture of Richard Stanley [Sta96] in the particular case of cographic matroids. We also prove that the multicomplexes constructed are M–shellable, so proving a conjecture of Manoj Chari [Cha97] again in the case of cographic matroids. The proofs use results on a game for graphs called the chip firing game.

[DMTCS-AA0119] Aaron Meyerowitz. Tiling the line with triples. In Robert Cori, Jacques Mazoyer, Michel Morvan, and Rémy Mosseri, editors, *Discrete Models: Combinatorics, Computation, and Geometry, DM-CCG 2001*, volume AA of *DMTCS Proceedings*, pages 257–274. Discrete Mathematics and Theoretical Computer Science, 2001.

http://www.dmtcs.org/proceedings/html/dmAA0119.abs.html

It is known the one dimensional prototile $\{0, a, a+b\}$ and its reflection $\{0, b, a+b\}$ always tile some interval. The subject has not received a great deal of further attention, although many interesting questions exist. All the information about tilings can be encoded in a finite digraph D_{ab}. We present several results about cycles and other structures in this graph. A number of conjectures and open problems are given.

[DMTCS-AA0120] Jean-Christophe Novelli and Dominique Rossin. On the toppling of a sand pile. In Robert Cori, Jacques Mazoyer, Michel Morvan, and Rémy Mosseri, editors, *Discrete Models: Combinatorics, Computation, and Geometry, DM-CCG 2001*, volume AA of *DMTCS Proceedings*, pages 275–286. Discrete Mathematics and Theoretical Computer Science, 2001.

http://www.dmtcs.org/proceedings/html/dmAA0120.abs.html

In this paper, we provide the first study of the sand pile model $SPM(0)$ where we assume that all the grains are numbered with a distinct integer. We obtain a lower bound on the number of terminal sand piles by establishing a bijection between a subset of these sand piles and the set of shifted Young tableaux. We then prove that this number is at least factorial.

[DMTCS-AA0121] Gilles Radenne. Tilings of a domain on a hexagon mesh with balanced 3-tiles. In Robert Cori, Jacques Mazoyer, Michel Morvan, and Rémy Mosseri, editors, *Discrete Models: Combinatorics, Computation, and Geometry, DM-CCG 2001*, volume AA of *DMTCS Proceedings*, pages 287–300. Discrete Mathematics and Theoretical Computer Science, 2001.

http://www.dmtcs.org/proceedings/html/dmAA0121.abs.html

In this article, we study the question of tilings on a hexagon mesh with balanced 3-tiles. This problem has been studied by Conway and Lagarias in [CL90], by studying the tiling groups, in fact a group containing the tiling-groups, and their Cayley graphs. We will use two different approaches. The first one is based on matchings in bipartite graphs, which in this case are in correspondance with tilings of domains by lozenges, and thus can be efficiently studied, using Thurston's algorithm (see [Thu90]). The second one is based on a color and balancing approach of Thurston's algorithm, exposed in [Fou96].

[DMTCS-AA0122] Jan Snellman. A poset classifying non-commutative term orders. In Robert Cori, Jacques Mazoyer, Michel Morvan, and Rémy Mosseri, editors, *Discrete Models: Combinatorics, Computation, and Geometry, DM-CCG 2001*, volume AA of *DMTCS Proceedings*, pages 301–314. Discrete Mathematics and Theoretical Computer Science, 2001.

http://www.dmtcs.org/proceedings/html/dmAA0122.abs.html

We study a poset N on the free monoid (X*) on a countable alphabet X. This poset is determined by the fact that its total extensions are precisely the standard term orders on X*. We also investigate the poset classifying degree-compatible standard term orders, and the poset classifying sorted term orders. For the latter poset, we give a Galois coconnection with the Young lattice.

[DMTCS-AA0123] Nicolas M. Thiéry. Computing minimal generating sets of invariant rings of permutation groups with SAGBI-Gröbner basis. In Robert Cori, Jacques Mazoyer, Michel Morvan, and Rémy Mosseri, editors, *Discrete Models: Combinatorics, Computation, and Geometry, DM-CCG 2001*, volume AA of *DMTCS Proceedings*, pages 315–328. Discrete Mathematics and Theoretical Computer Science, 2001.

http://www.dmtcs.org/proceedings/html/dmAA0123.abs.html

We present a characteristic-free algorithm for computing minimal generating sets of invariant rings of permutation groups. We circumvent the main weaknesses of the usual approaches (using classical Grbner basis inside the full polynomial ring, or pure linear algebra inside the invariant ring) by relying on the theory of SAGBI-Gröbner basis. This theory takes, in this special case, a strongly combinatorial flavor, which makes it particularly effective. Our algorithm does not require the computation of a Hironaka decomposition, nor even the computation of a system of parameters, and could be parallelized. Our implementation, as part of the library permuvar for mupad, is in many cases much more efficient than the other existing software.

[DMTCS-AA0124] Alexander Zvonkin. Megamaps: Construction and examples. In Robert Cori, Jacques Mazoyer, Michel Morvan, and Rémy Mosseri, editors, *Discrete Models: Combinatorics, Computation, and Geometry, DM-CCG 2001*, volume AA of *DMTCS Proceedings*, pages 329–340. Discrete Mathematics and Theoretical Computer Science, 2001.

http://www.dmtcs.org/proceedings/html/dmAA0124.abs.html

We consider the usual model of hypermaps or, equivalently, bipartite maps, represented by pairs of permutations that act transitively on a set of edges E. The specific feature of our construction is the fact that the elements of E are themselves (or are labelled by) rather complicated combinatorial objects, namely, the 4-constellations, while the permutations defining the hypermap originate from an action of the Hurwitz braid group on these 4-constellations. The motivation for the whole construction is the combinatorial representation of the parameter space of the ramified coverings of the Riemann sphere having four ramification points.

[DMTCS-AB0101] Malte Schmick and Mario Markus. Evidence for intermittency in a granular medium: experiments and simulations. In Michel Morvan and Éric Rémila, editors, *Discrete Models for Complex Systems, DMCS'03*, volume AB of *DMTCS Proceedings*, pages 1–10. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAB0101.abs.html

We present the first experimental demonstration of intermittency in a granular medium. The medium consists of magnets embedded within spheres. These spheres are placed in a horizontal Petri dish where they roll by virtue of an alternating, homogenous magnetic field. Due to collisions with the wall, clustering leads to self-organization into ring pieces circulating along the wall. The intermi ttent behaviour consists of an aperiodical alternation of this circular motion with a gaslike state extended over the entire dish. Molecular dynamic simulations agree with observations

[DMTCS-AB0102] Cosma Rohilla Shalizi. Optimal nonlinear prediction of random fields on networks. In Michel Morvan and Éric Rémila, editors, *Discrete Models for Complex Systems, DMCS'03*, volume AB of *DMTCS Proceedings*, pages 11–30. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAB0102.abs.html

It is increasingly common to encounter time-varying random fields on networks (metabolic networks, sensor arrays, distributed computing, etc.). This paper considers the problem of optimal, nonlinear prediction of these fields, showing from an information-theoretic perspective that it is formally identical to the problem of finding minimal local sufficient statistics. I derive general properties of these statistics, show that they can be composed into global predictors, and explore their recursive estimation properties. For the special case of discrete-valued fields, I describe a convergent algorithm to identify the local predictors from empirical data, with minimal prior information about the field, and no distributional assumptions.

[DMTCS-AB0103] Martin Nilsson and Steen Rasmussen. Cellular automata for simulating molecular self-assembly. In Michel Morvan and Éric Rémila, editors, *Discrete Models for Complex Systems, DMCS'03*, volume AB of *DMTCS Proceedings*, pages 31–42. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAB0103.abs.html

We present a lattice gas technique for simulating molecular self-assembly of amphiphilic polymers in aqueous environments. Water molecules, hydrocarbons tail-groups and amphiphilic head-groups are explicitly represented on a three dimensional discrete lattice. Molecules move on the lattice proportional to their continuous momentum. Collision rules preserve momentum and kinetic energy. Potential energy from molecular interactions are also included explicitly. Non-trivial thermodynamics of large scale and long time dynamics are studied. In this paper we specifically demonstrate how, from a random initial distribution, micelles are formed, and grow until they destabilize and divide. Eventually a steady state of growing and dividing micelles is formed.

[DMTCS-AB0104] Phan Ti, Ha Duong, and Éric Thierry. Dynamics of the picking transformation on integer partitions. In Michel Morvan and Éric Rémila, editors, *Discrete Models for Complex Systems, DMCS'03*, volume AB of *DMTCS Proceedings*, pages 43–56. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAB0104.abs.html

This paper studies a conservative transformation defined on families of finite sets. It consists in removing one element from each set and adding a new set composed of the removed elements. This transformation is conservative in the sense that the union of all sets of the family always remains the same.

[DMTCS-AB0105] Anahí Gajardo. A symbolic projection of langton's ant. In Michel Morvan and Éric Rémila, editors, *Discrete Models for Complex Systems, DMCS'03*, volume AB of *DMTCS Proceedings*, pages 57–68. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAB0105.abs.html

The Langton's ant is studied from the point of view of topological dynamical systems. A new approach which associate a subshift to the system is proposed. The transition rule is generalized to the family of biregular graphs $\Gamma(k, d)$ and the dependence of the dynamical system on k and d is analyzed. A classification of the $\Gamma(k, d)$ graphs based on the dynamical properties of the subshift is established. Also a hierarchy is defined on the graphs through the subset relation of the respective subshifts. The analysis are worked out by establishing an algebraic characterization of the forbidden words of the subshift.

[DMTCS-AB0106] Christopher L. Barrett, Harry B. Hunt, III, Madhav V. Marathe, S. S. Ravi, Daniel J. Rosenkrantz, and Richard E. Stearns. Predecessor and permutation existence problems for sequential dynamical systems. In Michel Morvan and Éric Rémila, editors, *Discrete Models for Complex Systems, DMCS'03*, volume AB of *DMTCS Proceedings*, pages 69–80. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAB0106.abs.html

A class of finite discrete dynamical systems, called Sequential Dynamical Systems (SDSs), was introduced in [BR99] as a formal model for analyzing simulation systems. Here, we address the complexity of two basic problems and their generalizations for SDSs.

[DMTCS-AB0107] Olivier Bodini. Tiling a rectangle with polyominoes. In Michel Morvan and Éric Rémila, editors, *Discrete Models for Complex Systems, DMCS'03*, volume AB of *DMTCS Proceedings*, pages 81–88. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAB0107.abs.html

A polycube in dimension d is a finite union of unit d-cubes whose vertices are on knots of the lattice Z^d. We show that, for each family of polycubes E, there exists a finite set F of bricks (parallelepiped rectangles) such that the bricks which can be tiled by E are exactly the bricks which can be tiled by F. Consequently, if we know the set F, then we have an algorithm to decide in polynomial time if a brick is tilable or not by the tiles of E.

[DMTCS-AB0108] Arnaud Dartois and Clémence Magnien. Results and conjectures on the sandpile identity on a lattice. In Michel Morvan and Éric Rémila, editors, *Discrete Models for Complex Systems, DMCS'03*, volume AB of *DMTCS Proceedings*, pages 89–102. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAB0108.abs.html

In this paper we study the identity of the Abelian Sandpile Model on a rectangular lattice. This configuration can be computed with the burning algorithm, which, starting from the empty lattice, computes a sequence of configurations, the last of which is the identity. We extend this algorithm to an infinite lattice, which allows us to prove that the first steps of the algorithm on a finite lattice are the same whatever its size. Finally we introduce a new configuration, which shares the intriguing properties of the identity, but is easier to study.

[DMTCS-AB0109] A. Del Lungo, E. Duchi, A. Frosini, and S. Rinaldi. Enumeration of convex polyominoes using the eco method. In Michel Morvan and Éric Rémila, editors, *Discrete Models for Complex Systems, DMCS'03*, volume AB of *DMTCS Proceedings*, pages 103–116. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAB0109.abs.html

ECO is a method for the enumeration of classes of combinatorial objects based on recursive constructions of such classes. In the first part of this paper we present a construction for the class of convex polyominoes based on the ECO method. Then we translate this construction into a succession rule. The final goal of the paper is to determine the generating function of convex polyominoes according to the semi-perimeter, and it is achieved by applying an idea introduced in [11].

[DMTCS-AB0110] Bruno Durand, Enrico Formenti, and Georges Varouchas. On undecidability of equicontinuity classification for cellular automata. In Michel Morvan and Éric Rémila, editors, *Discrete Models for Complex Systems, DMCS'03*, volume AB of *DMTCS Proceedings*, pages 117–128. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAB0110.abs.html

Equicontinuity classification is a popular classification of cellular automata based on their dynamical behavior. In this paper we prove that most of its classes are undecidable.

[DMTCS-AB0111] Bruno Durand, Enrico Formenti, Aristide Grange, and Zsuzsanna Róka. Number conserving cellular automata: new results on decidability and dynamics. In Michel Morvan and Éric Rémila, editors, *Discrete Models for Complex Systems, DMCS'03*, volume AB of *DMTCS Proceedings*, pages 129–140. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAB0111.abs.html

This paper is a survey on our recent results about number conserving cellular automata. First, we prove the linear time decidability of the property of number conservation. The sequel focuses on dynamical evolutions of number conserving cellular automata.

[DMTCS-AB0112] N. Lafaye de Micheaux, G. Lopez, P. Vitiello, and J. L. Beauvois. Formalizing the transformations of a cognitive universe. In Michel Morvan and Éric Rémila, editors, *Discrete Models for Complex Systems, DMCS'03*, volume AB of *DMTCS Proceedings*, pages 141–154. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAB0112.abs.html

In an effort to continue the pioneering work of Harary in USA and Flament in France, we have undertaken to develop, on an experimental basis, a formalized theory of systems of beliefs and their modifications. This theory uses the psycho-social concepts of theories of cognitive consistency and of the tools of discrete mathematics, such as rewriting and intervals within graphs. The axioms and rewriting rules are elaborated from experimental data, and we demonstrate that the system we have built has the property of termination. This result is in accordance with experimental observations that show that every subject having an inconsistent system of beliefs (i.e., one containing contradictions) makes this system evolve towards consistency to reach a simple, consistent reference framework.

[DMTCS-AB0113] Nazim Fatès. Experimental study of elementary cellular automata dynamics using the density parameter. In Michel Morvan and Éric Rémila, editors, *Discrete Models for Complex Systems, DMCS'03*, volume AB of *DMTCS Proceedings*, pages 155–166. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAB0113.abs.html

Classifying cellular automata in order to capture the notion of chaos algorithmically is a challenging problem than can be tackled in many ways. We here give a classification based on the computation of a macroscopic parameter, the d-spectrum, and show how our classifying scheme can be used to separate the chaotic ECA from the non-chaotic ones.

[DMTCS-AB0114] Panama Geer, Harry W. McLaughlin, and Keith Unsworth. Cellular lines: An introduction. In Michel Morvan and Éric Rémila, editors, *Discrete Models for Complex Systems, DMCS'03*, volume AB of *DMTCS Proceedings*, pages 167–178. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAB0114.abs.html

This paper provides a definition of a cellular line in a cellular array that is independent of the notion of a line in R^2. It also presents a way of determining whether or not a cell set is a cellular line. Brief statements about existence, uniqueness, and properties of cellular lines are included.

[DMTCS-AB0115] Nick Anzalone, John Baldwin, Ilya Bronshtein, and T. Kyle Petersen. A reciprocity theorem for monomer-dimer coverings. In Michel Morvan and Éric Rémila, editors, *Discrete Models for Complex Systems, DMCS'03*, volume AB of *DMTCS Proceedings*, pages 179–194. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAB0115.abs.html

The problem of counting monomer-dimer coverings of a lattice is a longstanding problem in statistical mechanics. It has only been exactly solved for the special case of dimer coverings in two dimensions ([Ka61], [TF61]). In earlier work, Stanley [St85] proved a reciprocity principle governing the number N(m,n) of dimer coverings of an m by n rectangular grid (also known as perfect matchings), where m is fixed and n is allowed to vary. As reinterpreted by Propp [P01], Stanley's result concerns the unique way of extending N(m,n) to n ¡ 0 so that the resulting bi-infinite sequence, N(m,n) for n in ZZ, satisfies a linear recurrence relation with constant coefficients. In particular, Stanley shows that N(m,n) is always an integer satisfying the relation N(m,-2-n) = epsilon N(m,n) where epsilon = 1 unless m = 2(mod 4) and n is odd, in which case epsilon = -1. Furthermore, Propp's method was applicable to higher-dimensional cases. This paper discusses similar investigations of the numbers M(m,n), of monomer-dimer coverings, or equivalently (not necessarily perfect) matchings of an m by n rectangular grid. We show that for each fixed m there is a unique way of extending M(m,n) to n ¡ 0 so that the resulting bi-infinite sequence, M(m,n) for n in ZZ, satisfies a linear recurrence relation with constant coefficients. We show that M(m,n), a priori a rational number, is always an integer, using a generalization of the combinatorial model offered by Propp. Lastly, we give a new statement of reciprocity in terms of multivariate generating functions from which Stanley's result follows.

[DMTCS-AC0100] Cyril Banderier and Christian Krattenthaler. Discrete random walks 2003: Introduction and acknowledgements. In Cyril Banderier and Christian Krattenthaler, editors, *Discrete Random Walks, DRW'03*, volume AC of *DMTCS Proceedings*, pages 1–8. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAC0100.abs.html

Presentation of the DRW2003 conference

[DMTCS-AC0101] Omer Angel. Random infinite permutations and the cyclic time random walk. In Cyril Banderier and Christian Krattenthaler, editors, *Discrete Random Walks, DRW'03*, volume AC of *DMTCS Proceedings*, pages 9–16. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAC0101.abs.html

The random stirring process is a natural random walk on the set of permutations of the vertex set of a graph. The cyclic time random walk is a self interacting random walk on a graph. It is influenced by its past, in that it is constrained to repeat its past choices if it returns to a previously visited edge after a multiple of some period of time. The two models are fundamentally equivalent to each other as well as to a certain coalescence and fragmentation process.

[DMTCS-AC0102] Nathanaël Berestycki and Rick Durrett. A phase transition in the random transposition random walk. In Cyril Banderier and Christian Krattenthaler, editors, *Discrete Random Walks, DRW'03*, volume AC of *DMTCS Proceedings*, pages 17–26. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAC0102.abs.html

Our work is motivated by Bourque-Pevzner's simulation study of the effectiveness of the parsimony method in studying genome rearrangement, and leads to a surprising result about the random transposition walk in continuous time on the group of permutations on n elements starting from the identity. Let D_t be the minimum number of transpositions needed to go back to the identity element from the location at time t. D_t undergoes a phase transition: for $0 < c \leq 1$, the distance $D_{cn/2}$ $cn/2$, i.e., the distance increases linearly with time; for $c > 1$, $D_{cn/2}$ $u(c)n$ where u is an explicit function satisfying $u(x) < x/2$. Moreover we describe the fluctuations of $D_{cn/2}$ about its mean at each of the three stages (subcritical, critical and supercritical). The techniques used involve viewing the cycles in the random permutation as a coagulation-fragmentation process and relating the behavior to the Erd#x151 s-Rényi random graph model.

[DMTCS-AC0103] Yao ban Chan and Anthony J. Guttmann. Some results for directed lattice walkers in a strip. In Cyril Banderier and Christian Krattenthaler, editors, *Discrete Random Walks, DRW'03*, volume AC of *DMTCS Proceedings*, pages 27–38. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAC0103.abs.html

Using a transfer matrix method, we present some results for directed lattice walkers in a horizontal strip of finite width. Some cases with two walkers in a small width are solved exactly, as are a couple of cases with vicious walkers in a small width; a conjecture is made for a case with three walkers. We also derive the general transfer matrix for two walkers. Lastly, we examine the dependence of the growth constant on the width and friendliness.

[DMTCS-AC0104] Dayue Chen and Yuval Peres. The speed of simple random walk and anchored expansion on percolation clusters: an overview. In Cyril Banderier and Christian Krattenthaler, editors, *Discrete Random Walks, DRW'03*, volume AC of *DMTCS Proceedings*, pages 39–44. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAC0104.abs.html

Benjamini, Lyons and Schramm (1999) considered properties of an infinite graph G, and the simple random walk on it, that are preserved by random perturbations. To address problems raised by those authors, we study simple random walk on the infinite percolation cluster in Cayley graphs of certain amenable groups known as "lamplighter groups". We prove that zero speed for random walk on a lamplighter group implies zero speed for random walk on an infinite cluster, for any supercritical percolation parameter p. For p large enough, we also establish the converse. We prove that if G has a positive anchored expansion constant then so does every infinite cluster of independent percolation with parameter p sufficiently close to 1;We also show that positivity of the anchored expansion constant is preserved under a random stretch if, and only if, the stretching law has an exponential tail.

[DMTCS-AC0105] Endre Csáki and Yueyun Hu. Lengths and heights of random walk excursions. In Cyril Banderier and Christian Krattenthaler, editors, *Discrete Random Walks, DRW'03*, volume AC of *DMTCS Proceedings*, pages 45–52. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAC0105.abs.html

Consider a simple symmetric random walk on the line. The parts of the random walk between consecutive returns to the origin are called excursions. The heights and lengths of these excursions can be arranged in decreasing order. In this paper we give the exact and limiting distributions of these ranked quantities. These results are analogues of the corresponding results of Pitman and Yor [1997, 1998, 2001] for Brownian motion.

[DMTCS-AC0106] Ho-Kwok Dai and Hung-Chi Su. Approximation and analytical studies of inter-clustering performances of space-filling curves. In Cyril Banderier and Christian Krattenthaler, editors, *Discrete Random Walks, DRW'03*, volume AC of *DMTCS Proceedings*, pages 53–68. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAC0106.abs.html

A discrete space-filling curve provides a linear traversal/indexing of a multi-dimensional grid space. This paper presents an application of random walk to the study of inter-clustering of space-filling curves and an analytical study on the inter-clustering performances of 2-dimensional Hilbert and z-order curve families. Two underlying measures are employed: the mean inter-cluster distance over all inter-cluster gaps and the mean total inter-cluster distance over all subgrids. We show how approximating the mean inter-cluster distance statistics of continuous multi-dimensional space-filling curves fits into the formalism of random walk, and derive the exact formulas for the two statistics for both curve families. The excellent agreement in the approximate and true mean inter-cluster distance statistics suggests that the random walk may furnish an effective model to develop approximations to clustering and locality statistics for space-filling curves. Based upon the analytical results, the asymptotic comparisons indicate that z-order curve family performs better than Hilbert curve family with respect to both statistics.

[DMTCS-AC0107] Moez Draief, Jean Mairesse, and Neil O'Connell. Joint burke's theorem and RSK representation for a queue and a store. In Cyril Banderier and Christian Krattenthaler, editors, *Discrete Random Walks, DRW'03*, volume AC of *DMTCS Proceedings*, pages 69–82. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAC0107.abs.html

Consider the single server queue with an infinite buffer and a FIFO discipline, either of type $M/M/1$ or Geom/Geom/1. Denote by A the arrival process and by s the services. Assume the stability condition to be satisfied. Denote by D the departure process in equilibrium and by r the time spent by the customers at the very back of the queue. We prove that (D, r) has the same law as (A, s) which is an extension of the classical Burke Theorem. In fact, r can be viewed as the departures from a dual $storage$ model. This duality between the two models also appears when studying the transient behavior of a tandem by means of the RSK algorithm: the first and last row of the resulting semi-standard Young tableau are respectively the last instant of departure in the queue and the total number of departures in the store.

[DMTCS-AC0108] Michael Drmota. Discrete random walks on one-sided "periodic" graphs. In Cyril Banderier and Christian Krattenthaler, editors, *Discrete Random Walks, DRW'03*, volume AC of *DMTCS Proceedings*, pages 83–94. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAC0108.abs.html

In this paper we consider discrete random walks on infinite graphs that are generated by copying and shifting one finite (strongly connected) graph into one direction and connecting successive copies always in the same way. With help of generating functions it is shown that there are only three types for the asymptotic behaviour of the random walk. It either converges to the stationary distribution or it can be approximated in terms of a reflected Brownian motion or by a Brownian motion. In terms of Markov chains these cases correspond to positive recurrence, to null recurrence, and to non recurrence.

[DMTCS-AC0109] Rick Durrett. Rigorous result for the CHKNS random graph model. In Cyril Banderier and Christian Krattenthaler, editors, *Discrete Random Walks, DRW'03*, volume AC of *DMTCS Proceedings*, pages 95–104. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAC0109.abs.html

We study the phase transition in a random graph in which vertices and edges are added at constant rates. Two recent papers in Physical Review E by Callaway, Hopcroft, Kleinberg, Newman, and Strogatz, and Dorogovstev, Mendes, and Samukhin have computed the critical value of this model, shown that the fraction of vertices in finite clusters is infinitely differentiable at the critical value, and that in the subcritical phase the cluster size distribution has a polynomial decay rate with a continuously varying power. Here we sketch rigorous proofs for the first and third results and a new estimates about connectivity probabilities at the critical value.

[DMTCS-AC0110] L. R. G. Fontes, M. Vachkovskaia, and A. Yambartsev. Entropic repulsion on a rarefied wall. In Cyril Banderier and Christian Krattenthaler, editors, *Discrete Random Walks, DRW'03*, volume AC of *DMTCS Proceedings*, pages 105–112. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAC0110.abs.html

We consider the motion of a discrete d-dimensional random surface interacting by exclusion with a rarefied wall. The dynamics is given by the serial harness process. We prove that the process delocalizes iff the mean number of visits to the set of sites where the wall is present by some random walk is infinite. In case where there is a delocalization, bounds on its speed are obtained.

[DMTCS-AC0111] David Gamarnik. Linear phase transition in random linear constraint satisfaction problems. In Cyril Banderier and Christian Krattenthaler, editors, *Discrete Random Walks, DRW'03*, volume AC of *DMTCS Proceedings*, pages 113–126. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAC0111.abs.html

Our model is a generalized linear programming relaxation of a much studied random K-SAT problem. Specifically, a set of linear constraints C on K variables is fixed. From a pool of n variables, K variables are chosen uniformly at random and a constraint is chosen from C also uniformly at random. This procedure is repeated m times independently. We are interested in whether the resulting linear programming problem is feasible. We prove that the feasibility property experiences a linear phase transition, when $n\to\infty$ and $m = cn$ for a constant c. Namely, there exists a critical value c^* such that, when $c < c^*$, the problem is feasible or is asymptotically almost feasible, as $n\to\infty$, but, when $c > c^*$, the "distance" to feasibility is at least a positive constant independent of n. Our result is obtained using the combination of a powerful local weak convergence method developed in Aldous [1992, 2000], Aldous and Steele [2003], Steele [2002] and martingale techniques. By exploiting a linear programming duality, our theorem implies the following result in the context of sparse random graphs $G(n, cn)$ on n nodes with cn edges, where edges are equipped with randomly generated weights. Let $M(n, c)$ denote maximum weight matching in $G(n, cn)$. We prove that when c is a constant and $n\to\infty$, the limit $lim_{n\to\infty}M(n, c)/n$, exists, with high probability. We further extend this result to maximum weight b-matchings also in $G(n, cn)$.

[DMTCS-AC0112] Michael L. Green, Alan Krinik, Carrie Mortensen, Gerardo Rubino, and Randall J. Swift. Transient probability functions: A sample path approach. In Cyril Banderier and Christian Krattenthaler, editors, *Discrete Random Walks, DRW'03*, volume AC of *DMTCS Proceedings*, pages 127–136. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAC0112.abs.html

A new approach is used to determine the transient probability functions of Markov processes. This new solution method is a sample path counting approach and uses dual processes and randomization. The approach is illustrated by determining transient probability functions for a three-state Markov process. This approach also provides a way to calculate transient probability functions for Markov processes which have specific sample path characteristics.

[DMTCS-AC0113] Anders Karlsson. Some remarks concerning harmonic functions on homogeneous graphs. In Cyril Banderier and Christian Krattenthaler, editors, *Discrete Random Walks, DRW'03*, volume AC of *DMTCS Proceedings*, pages 137–144. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAC0113.abs.html

We obtain a new result concerning harmonic functions on infinite Cayley graphs X: either every non-constant harmonic function has infinite radial variation in a certain uniform sense, or there is a nontrivial boundary with hyperbolic properties at infinity of X. In the latter case, relying on a theorem of Woess, it follows that the Dirichlet problem is solvable with respect to this boundary. Certain relations to group cohomology are also discussed.

[DMTCS-AC0114] Oleksiy Khorunzhiy. Rooted trees and moments of large sparse random matrices. In Cyril Banderier and Christian Krattenthaler, editors, *Discrete Random Walks, DRW'03*, volume AC of *DMTCS Proceedings*, pages 145–154. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAC0114.abs.html

In these expository paper we describe the role of the rooted trees as a base for convenient tools in studies of random matrices. Regarding the Wigner ensemble of random matrices, we represent main ingredients of this approach. Also we refine our previous result on the limit of the spectral norm of adjacency matrix of large random graphs.

[DMTCS-AC0115] Guy Louchard. The number of distinct part sizes of some multiplicity in compositions of an integer. a probabilistic analysis. In Cyril Banderier and Christian Krattenthaler, editors, *Discrete Random Walks, DRW'03*, volume AC of *DMTCS Proceedings*, pages 155–170. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAC0115.abs.html

Random compositions of integers are used as theoretical models for many applications. The degree of distinctness of a composition is a natural and important parameter. A possible measure of distinctness is the number X of distinct parts (or components). This parameter has been analyzed in several papers. In this article we consider a variant of the distinctness: the number $X(m)$ of distinct parts of multiplicity m that we call the m-distinctness. A first motivation is a question asked by Wilf for random compositions: what is the asymptotic value of the probability that a randomly chosen part size in a random composition of an integer ν has multiplicity m. This is related to $\mathbf{E}(X(m))$, which has been analyzed by Hitczenko, Rousseau and Savage. Here, we investigate, from a probabilistic point of view, the first full part, the maximum part size and the distribution of $X(m)$. We obtain asymptotically, as $\nu \to \infty$, the moments and an expression for a continuous distribution ϕ, the (discrete) distribution of $X(m, \nu)$ being computable from ϕ.

[DMTCS-AC0116] Fabio P. Machado. Percolation on a non-homogeneous Poisson blob process. In Cyril Banderier and Christian Krattenthaler, editors, *Discrete Random Walks, DRW'03*, volume AC of *DMTCS Proceedings*, pages 171–172. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAC0116.abs.html

We present the main results of a study for the existence of vacant and occupied unbounded connected components in a non-homogeneous Poisson blob process. The method used in the proofs is a multi-scale percolation comparison.

[DMTCS-AC0117] Philippe Marchal. Constructing a sequence of random walks strongly converging to Brownian motion. In Cyril Banderier and Christian Krattenthaler, editors, *Discrete Random Walks, DRW'03*, volume AC of *DMTCS Proceedings*, pages 181–190. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAC0117.abs.html

We give an algorithm which constructs recursively a sequence of simple random walks on **Z** converging almost surely to a Brownian motion. One obtains by the same method conditional versions of the simple random walk converging to the excursion, the bridge, the meander or the normalized pseudobridge.

[DMTCS-AC0118] James B. Martin. Reconstruction thresholds on regular trees. In Cyril Banderier and Christian Krattenthaler, editors, *Discrete Random Walks, DRW'03*, volume AC of *DMTCS Proceedings*, pages 191–204. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAC0118.abs.html

We consider the model of broadcasting on a tree, with binary state space, on the infinite rooted tree T^k in which each node has k children. The root of the tree takes a random value 0 or 1, and then each node passes a value independently to each of its children according to a 2x2 transition matrix **P**. We say that reconstruction is possible if the values at the dth level of the tree contain non-vanishing information about the value at the root as $d \to \infty$. Extending a method of Brightwell and Winkler, we obtain new conditions under which reconstruction is impossible, both in the general case and in the special case $p_{11} = 0$. The latter case is closely related to the hard-core model from statistical physics; a corollary of our results is that, for the hard-core model on the $(k+1)$-regular tree with activity $\lambda = 1$, the unique simple invariant Gibbs measure is extremal in the set of Gibbs measures, for any $k \geq 2$.

[DMTCS-AC0119] Massimiliano Mattera. Annihilating random walks and perfect matchings of planar graphs. In Cyril Banderier and Christian Krattenthaler, editors, *Discrete Random Walks, DRW'03*, volume AC of *DMTCS Proceedings*, pages 173–180. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAC0119.abs.html

We study annihilating random walks on Z using techniques of P.W. Kasteleyn and R. Kenyon on perfect matchings of planar graphs. We obtain the asymptotic of the density of remaining particles and the partition function of the underlying statistical mechanical model.

[DMTCS-AC0120] Mikhail Menshikov, Dimitri Petritis, and Serguei Popov. Bindweeds or random walks in random environments on multiplexed trees and their asympotics. In Cyril Banderier and Christian Krattenthaler, editors, *Discrete Random Walks, DRW'03*, volume AC of *DMTCS Proceedings*, pages 205–216. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAC0120.abs.html

We report on the asymptotic behaviour of a new model of random walk, we term the bindweed model, evolving in a random environment on an infinite multiplexed tree. The term multiplexed means that the model can be viewed as a nearest neighbours random walk on a tree whose vertices carry an internal degree of freedom from the finite set $\{1, ..., d\}$, for some integer d. The consequence of the internal degree of freedom is an enhancement of the tree graph structure induced by the replacement of ordinary edges by multi-edges, indexed by the set $\{1, ..., d\}\times\{1, ..., d\}$. This indexing conveys the information on the internal degree of freedom of the vertices contiguous to each edge. The term random environment means that the jumping rates for the random walk are a family of edge-indexed random variables, independent of the natural filtration generated by the random variables entering in the definition of the random walk; their joint distribution depends on the index of each component of the multi-edges. We study the large time asymptotic behaviour of this random walk and classify it with respect to positive recurrence or transience in terms of a specific parameter of the probability distribution of the jump rates. This classifying parameter is shown to coincide with the critical value of a matrix-valued multiplicative cascade on the ordinary tree (i.e. the one without internal degrees of freedom attached to the vertices) having the same vertex set as the state space of the random walk. Only results are presented here since the detailed proofs will appear elsewhere.

[DMTCS-AC0121] Donatella Merlini. Generating functions for the area below some lattice paths. In Cyril Banderier and Christian Krattenthaler, editors, *Discrete Random Walks, DRW'03*, volume AC of *DMTCS Proceedings*, pages 217–228. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAC0121.abs.html

We study some lattice paths related to the concept of generating trees. When the matrix associated to this kind of trees is a Riordan array $D = (d(t), h(t))$, we are able to find the generating function for the total area below these paths expressed in terms of the functions $d(t)$ and $h(t)$.

[DMTCS-AC0122] Saibal Mitra and Bernard Nienhuis. Osculating random walks on cylinders. In Cyril Banderier and Christian Krattenthaler, editors, *Discrete Random Walks, DRW'03*, volume AC of *DMTCS Proceedings*, pages 259–264. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAC0122.abs.html

We consider random paths on a square lattice which take a left or a right turn at every vertex. The possible turns are taken with equal probability, except at a vertex which has been visited before. In such case the vertex is left via the unused edge. When the initial edge is reached the path is considered completed. We also consider families of such paths which together cover every edge of the lattice once and visit every vertex twice. Because these paths may touch but not intersect each other and themselves, we call them osculating walks. The ensemble of such families is also known as the dense $O(n = 1)$ model. We consider in particular such paths in a cylindrical geometry, with the cylindrical axis parallel with one of the lattice directions. We formulate a conjecture for the probability that a face of the lattice is surrounded by m distinct osculating paths. For even system sizes we give a conjecture for the probability that a path winds round the cylinder. For odd system sizes we conjecture the probability that a point is visited by a path spanning the infinite length of the cylinder. Finally we conjecture an expression for the asymptotics of a binomial determinant

[DMTCS-AC0123] Michel Nguyên Thê. Area of Brownian motion with generatingfunctionology. In Cyril Banderier and Christian Krattenthaler, editors, *Discrete Random Walks, DRW'03*, volume AC of *DMTCS Proceedings*, pages 229–242. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAC0123.abs.html

This paper gives a survey of the limit distributions of the areas of different types of random walks, namely Dyck paths, bilateral Dyck paths, meanders, and Bernoulli random walks, using the technology of generating functions only.

[DMTCS-AC0124] Pierre Nicodème. q-gram analysis and urn models. In Cyril Banderier and Christian Krattenthaler, editors, *Discrete Random Walks, DRW'03*, volume AC of *DMTCS Proceedings*, pages 243–258. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAC0124.abs.html

Words of fixed size q are commonly referred to as q-grams. We consider the problem of q-gram filtration, a method commonly used to speed up sequence comparison. We are interested in the statistics of the number of q-grams common to two random texts (where multiplicities are not counted) in the non uniform Bernoulli model. In the exact and dependent model, when omitting border effects, a q-gram in a random sequence depends on the $q-1$ preceding q-grams. In an approximate and independent model, we draw randomly a q-gram at each position, independently of the others positions. Using ball and urn models, we analyze the independent model. Numerical simulations show that this model is an excellent first order approximation to the dependent model. We provide an algorithm to compute the moments.

[DMTCS-AC0125] Alois Panholzer. Non-crossing trees revisited: cutting down and spanning subtrees. In Cyril Banderier and Christian Krattenthaler, editors, *Discrete Random Walks, DRW'03*, volume AC of *DMTCS Proceedings*, pages 265–276. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAC0125.abs.html

Here we consider two parameters for random non-crossing trees: *(i)* the number of random cuts to destroy a size-n non-crossing tree and *(ii)* the spanning subtree-size of p randomly chosen nodes in a size-n non-crossing tree. For both quantities, we are able to characterise for $n\to\infty$ the limiting distributions. Non-crossing trees are almost conditioned Galton-Watson trees, and it has been already shown, that the contour and other usually associated discrete excursions converge, suitable normalised, to the Brownian excursion. We can interpret parameter *(ii)* as a functional of a conditioned random walk, and although we do not have such an interpretation for parameter *(i)*, we obtain here limiting distributions, that are also arising as limits of some functionals of conditioned random walks.

[DMTCS-AC0126] Serguei Yu. Popov. Frogs and some other interacting random walks models. In Cyril Banderier and Christian Krattenthaler, editors, *Discrete Random Walks, DRW'03*, volume AC of *DMTCS Proceedings*, pages 277–288. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAC0126.abs.html

We review some recent results for a system of simple random walks on graphs, known as *frog model*. Also, we discuss several modifications of this model, and present a few open problems. A simple version of the frog model can be described as follows: There are active and sleeping particles living on some graph. Each active particle performs a simple random walk with discrete time and at each moment it may disappear with probability $1 - p$. When an active particle hits a sleeping particle, the latter becomes active.

[DMTCS-AC0127] Klaus Simon and Beat Trachsler. A random walk approach for light scattering in material. In Cyril Banderier and Christian Krattenthaler, editors, *Discrete Random Walks, DRW'03*, volume AC of *DMTCS Proceedings*, pages 289–300. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAC0127.abs.html

Understanding reflection is one of the key competences in graphic arts industry. A very popular approach was given by Kubelka and Munk [1931] who derived a simple relationship between the scattering and absorption coefficients and the overall reflectance. This paper presents an alternative approach which describes the behavior of light in matter as a special kind of random walk.

[DMTCS-AC0128] András Telcs. The volume and time comparison principle and transition probability estimates for random walks. In Cyril Banderier and Christian Krattenthaler, editors, *Discrete Random Walks, DRW'03*, volume AC of *DMTCS Proceedings*, pages 301–308. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAC0128.abs.html

This paper presents necessary and sufficient conditions for on- and off-diagonal transition probability estimates for random walks on weighted graphs. On the integer lattice and on may fractal type graphs both the volume of a ball and the mean exit time from a ball are independent of the center, uniform in space. Here the upper estimate is given without such restriction and two-sided estimate is given if the mean exit time is independent of the center but the volume is not.

[DMTCS-AC0129] Leonid Tolmatz. The saddle point method for the integral of the absolute value of the brownian motion. In Cyril Banderier and Christian Krattenthaler, editors, *Discrete Random Walks, DRW'03*, volume AC of *DMTCS Proceedings*, pages 309–324. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAC0129.abs.html

The distribution function of the integral of the absolute value of the Brownian motion was expressed by L.Takács in the form of various series. In the present paper we determine the exact tail asymptotics of this distribution function. The proposed method is applicable to a variety of other Wiener functionals as well.

[DMTCS-AC0130] Valentin Topchii and Vladimir Vatutin. Individuals at the origin in the critical catalytic branching random walk. In Cyril Banderier and Christian Krattenthaler, editors, *Discrete Random Walks, DRW'03*, volume AC of *DMTCS Proceedings*, pages 325–332. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAC0130.abs.html

A continuous time branching random walk on the lattice **Z** is considered in which individuals may produce children at the origin only. Assuming that the underlying random walk is symmetric and the offspring reproduction law is critical we prove a conditional limit theorem for the number of individuals at the origin.

[DMTCS-AC0131] Alessandro Vezzani, Davide Cassi, and Raffaella Burioni. Average properties of combinatorial problems and thermodynamics of spin models on graphs. In Cyril Banderier and Christian Krattenthaler, editors, *Discrete Random Walks, DRW'03*, volume AC of *DMTCS Proceedings*, pages 333–344. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAC0131.abs.html

The study of thermodynamic properties of classical spin models on infinite graphs naturally leads to consider the new combinatorial problems of random-walks and percolation on the average. Indeed, spin models with $O(n)$ continuous symmetry present spontaneous magnetization only on transient on the average graphs, while models with discrete symmetry (Ising and Potts) are spontaneously magnetized on graphs exhibiting percolation on the average. In this paper we define the combinatorial problems on the average, showing that they give rise to classifications of graph topology which are different from the ones obtained in usual (local) random-walks and percolation. Furthermore, we illustrate the theorem proving the correspondence between Potts model and average percolation.

[DMTCS-AC0132] Nisheeth Vishnoi. Non uniform random walks. In Cyril Banderier and Christian Krattenthaler, editors, *Discrete Random Walks, DRW'03*, volume AC of *DMTCS Proceedings*, pages 345–358. Discrete Mathematics and Theoretical Computer Science, 2003.

http://www.dmtcs.org/proceedings/html/dmAC0132.abs.html

Given $\epsilon_i \in [0,1)$ for each $1 < i < n$, a particle performs the following random walk on $\{1, 2, ..., n\}$:
If the particle is at n, it chooses a point uniformly at random (u.a.r.) from $\{1, ..., n-1\}$. If the current position of the particle is m $(1 < m < n)$, with probability ϵ_m it decides to go back, in which case it chooses a point u.a.r. from $\{m+1, ..., n\}$. With probability $1 - \epsilon_m$ it decides to go forward, in case it chooses a point u.a.r. from $\{1, ..., m-1\}$. The particle moves to the selected point.
What is the expected time taken by the particle to reach 1 if it starts the walk at n?
Apart from being a natural variant of the classical one dimensional random walk, variants and special cases of this problem arise in Theoretical Computer Science [Linial, Fagin, Karp, Vishnoi].
In this paper we study this problem and observe interesting properties of this walk. First we show that the expected number of times the particle visits i (before getting absorbed at 1) is the same when the walk is started at j, for all $j > i$. Then we show that for the following parameterized family of ϵ's: $\epsilon_i = (n-i)/(n-i+\alpha \cdot (i-1)), 1 < i < n$ where α does not depend on i, the expected number of times the particle visits i is the same when the walk is started at j, for all $j < i$. Using these observations we obtain the expected absorption time for this family of ϵ's. As α varies from infinity to 1, this time goes from $\Theta(logn)$ to $\Theta(n)$.
Finally we study the behavior of the expected convergence time as a function of ϵ. It remains an open question to determine whether this quantity increases when all ϵ's are increased. We give some preliminary results to this effect.

[DMTCS-AD0101] Rafik Aguech, Nabil Lasmar, and Hosam Mahmoud. Distribution of inter-node distances in digital trees. In Conrado Martínez, editor, *2005 International Conference on Analysis of Algorithms*, volume AD of *DMTCS Proceedings*, pages 1–10. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAD0101.abs.html

We investigate distances between pairs of nodes in digital trees (digital search trees (DST), and tries). By analytic techniques, such as the Mellin Transform and poissonization, we describe a program to determine the moments of these distances. The program is illustrated on the mean and variance. One encounters delayed Mellin transform equations, which we solve by inspection. Interestingly, the unbiased case gives a bounded variance, whereas the biased case gives a variance growing with the number of keys. It is therefore possible in the biased case to show that an appropriately normalized version of the distance converges to a limit. The complexity of moment calculation increases substantially with each higher moment; A shortcut to the limit is needed via a method that avoids the computation of all moments. Toward this end, we utilize the contraction method to show that in biased digital search trees the distribution of a suitably normalized version of the distances approaches a limit that is the fixed-point solution (in the Wasserstein space) of a distributional equation. An explicit solution to the fixed-point equation is readily demonstrated to be Gaussian.

[DMTCS-AD0102] M. Archibald. Position of the maximum in a sequence with geometric distribution. In Conrado Martínez, editor, *2005 International Conference on Analysis of Algorithms*, volume AD of *DMTCS Proceedings*, pages 11–16. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAD0102.abs.html

As a sequel to [arch04], the position of the maximum in a geometrically distributed sample is investigated. Samples of length n are considered, where the maximum is required to be in the first d positions. The probability that the maximum occurs in the first d positions is sought for d dependent on n (as opposed to d fixed in [arch04]). Two scenarios are discussed. The first is when $d = \alpha n$ for $0 < \alpha \leq 1$, where Mellin transforms are used to obtain the asymptotic results. The second is when $1 \leq d = o(n)$.

[DMTCS-AD0103] József Balogh, Boris Pittel, and Gelasio Salazar. Near–perfect non-crossing harmonic matchings in randomly labeled points on a circle. In Conrado Martínez, editor, *2005 International Conference on Analysis of Algorithms*, volume AD of *DMTCS Proceedings*, pages 17–26. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAD0103.abs.html

Consider a set S of points in the plane in convex position, where each point has an integer label from $\{0, 1, \ldots, n-1\}$. This naturally induces a labeling of the edges: each edge (i, j) is assigned label $i + j$, modulo n. We propose the algorithms for finding large non–crossing *harmonic* matchings or paths, i. e. the matchings or paths in which no two edges have the same label. When the point labels are chosen uniformly at random, and independently of each other, our matching algorithm with high probability (w.h.p.) delivers a nearly–perfect matching, a matching of size $n/2 - O(n^{1/3} ln n)$.

[DMTCS-AD0104] Y. Baryshnikov, E. Coffman, J. Feng, and P. Momčilović. Asymptotic analysis of a nonlinear AIMD algorithm. In Conrado Martínez, editor, *2005 International Conference on Analysis of Algorithms*, volume AD of *DMTCS Proceedings*, pages 27–38. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAD0104.abs.html

The Additive-Increase-Multiplicative Decrease (AIMD) algorithm is an effective technique for controlling competitive access to a shared resource. Let N be the number of users and let $x_i(t)$ be the amount of the resource in possession of the i-th user. The allocations $x_i(t)$ increase linearly until the aggregate demand $\sum_i x_i(t)$ exceeds a given nominal capacity, at which point a user is selected at a random time and its allocation reduced from $x_i(t)$ to $x_i(t)/\gamma$, for some given parameter $\gamma > 1$. In our new, generalized version of AIMD, the choice of users to have their allocations cut is determined by a selection rule whereby the probabilities of selection are proportional to $x_i^\alpha(t)/\sum_j x_j^\alpha$, with α a parameter of the policy. Variations of parameters allows one to adjust fairness under AIMD (as measured for example by the variance of $x_i(t)$) as well as to provide for differentiated service. The primary contribution here is an asymptotic, large-N analysis of the above nonlinear AIMD algorithm within a baseline mathematical model that leads to explicit formulas for the density function governing the allocations $x_i(t)$ in statistical equilibrium. The analysis yields explicit formulas for measures of fairness and several techniques for supplying differentiated service via AIMD.

[DMTCS-AD0105] Daniel Berend and Vladimir Braverman. Convex hull for intersections of random lines. In Conrado Martínez, editor, *2005 International Conference on Analysis of Algorithms*, volume AD of *DMTCS Proceedings*, pages 39–48. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAD0105.abs.html

The problem of finding the convex hull of the intersection points of random lines was studied in [dt] and [new], and algorithms with expected linear time were found. We improve the previous results of the model in [dt] by giving a universal algorithm for a wider range of distributions.

[DMTCS-AD0106] Cary Cherng and Richard E. Ladner. Cache efficient simple dynamic programming. In Conrado Martínez, editor, *2005 International Conference on Analysis of Algorithms*, volume AD of *DMTCS Proceedings*, pages 49–58. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAD0106.abs.html

New cache-oblivious and cache-aware algorithms for simple dynamic programming based on Valiant's context-free language recognition algorithm are designed, implemented, analyzed, and empirically evaluated with timing studies and cache simulations. The studies show that for large inputs the cache-oblivious and cache-aware dynamic programming algorithms are significantly faster than the standard dynamic programming algorithm.

[DMTCS-AD0107] Christian Costermans, Jean-Yves Enjalbert, and Hoang Ngoc Minh. Algorithmic and combinatoric aspects of multiple harmonic sums. In Conrado Martínez, editor, *2005*

International Conference on Analysis of Algorithms, volume AD of *DMTCS Proceedings*, pages 59–70. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAD0107.abs.html

Ordinary generating series of *multiple* harmonic sums admit a *full* singular expansion in the basis of functions
$\{(1-z)^{\alpha} log^{\beta}(1-z)\}_{\alpha\in\mathbb{Z},\beta\in\mathbb{N}}$, near the singularity $z=1$. A *constructive* proof of this result is given, and, by *combinatoric* aspects, an explicit evaluation of Taylor coefficients of functions in some *polylogarithmic* algebra is obtained. In particular, the *asymptotic expansion* of multiple harmonic sums is easily deduced.

[DMTCS-AD0108] Benoît Daireaux, Véronique Maume-Deschamps, and Brigitte Vallée. The Lyapunov tortoise and the dyadic hare. In Conrado Martínez, editor, *2005 International Conference on Analysis of Algorithms*, volume AD of *DMTCS Proceedings*, pages 71–94. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAD0108.abs.html

We study a gcd algorithm directed by Least Significant Bits, the so–called LSB algorithm, and provide a precise average–case analysis of its main parameters [number of iterations, number of shifts, etc...]. This analysis is based on a precise study of the dynamical systems which provide a continuous extension of the algorithm, and, here, it is proved convenient to use both a 2–adic extension and a real one. This leads to the framework of products of random matrices, and our results thus involve a constant γ which is the Lyapunov exponent of the set of matrices relative to the algorithm. The algorithm can be viewed as a race between a dyadic hare with a speed of 2 bits by step and a "real" tortoise with a speed equal to $\gamma/log 2 \sim 0.05$ bits by step. Even if the tortoise starts before the hare, the hare easily catches up with the tortoise [unlike in Aesop's fable [Ae]...], and the algorithm terminates.

[DMTCS-AD0109] Julien Fayolle and Mark Daniel Ward. Analysis of the average depth in a suffix tree under a Markov model. In Conrado Martínez, editor, *2005 International Conference on Analysis of Algorithms*, volume AD of *DMTCS Proceedings*, pages 95–104. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAD0109.abs.html

In this report, we prove that under a Markovian model of order one, the average depth of suffix trees of index n is asymptotically similar to the average depth of tries (a.k.a. digital trees) built on n independent strings. This leads to an asymptotic behavior of $(log n)/h + C$ for the average of the depth of the suffix tree, where h is the entropy of the Markov model and C is constant. Our proof compares the generating functions for the average depth in tries and in suffix trees; the difference between these generating functions is shown to be asymptotically small. We conclude by using the asymptotic behavior of the average depth in a trie under the Markov model found by Jacquet and Szpankowski ([JaSz91]).

[DMTCS-AD0110] James Allen Fill and Nevin Kapur. A repertoire for additive functionals of uniformly distributed m-ary search trees. In Conrado Martínez, editor, *2005 International Conference on Analysis of Algorithms*, volume AD of *DMTCS Proceedings*, pages 105–114. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAD0110.abs.html

Using recent results on singularity analysis for Hadamard products of generating functions, we obtain the limiting distributions for additive functionals on m-ary search trees on n keys with toll sequence (i) n^α with $\alpha \geq 0$ ($\alpha = 0$ and $\alpha = 1$ correspond roughly to the space requirement and total path length, respectively); (ii) $ln\binom{n}{m-1}$, which corresponds to the so-called shape functional; and (iii) $\mathbf{1}_{n=m-1}$, which corresponds to the number of leaves.

[DMTCS-AD0111] Mihai Furis, Paweł Hitczenko, and Jeremy Johnson. Cache miss analysis of WHT algorithms. In Conrado Martínez, editor, *2005 International Conference on Analysis of Algorithms*, volume AD of *DMTCS Proceedings*, pages 115–124. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAD0111.abs.html

On modern computers memory access patterns and cache utilization are as important, if not more important, than operation count in obtaining high-performance implementations of algorithms. In this work, the memory behavior of a large family of algorithms for computing the Walsh-Hadamard transform, an important signal processing transform related to the fast Fourier transform, is investigated. Empirical evidence shows that the family of algorithms exhibit a wide range of performance, despite the fact that all algorithms perform the same number of arithmetic operations. Different algorithms, while having the same number of memory operations, access memory in different patterns and consequently have different numbers of cache misses. A recurrence relation is derived for the number of cache misses and is used to determine the distribution of cache misses over the space of WHT algorithms.

[DMTCS-AD0112] Éric Fusy. Quadratic exact-size and linear approximate-size random generation of planar graphs. In Conrado Martínez, editor, *2005 International Conference on Analysis of Algorithms*, volume AD of *DMTCS Proceedings*, pages 125–138. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAD0112.abs.html

This extended abstract introduces a new algorithm for the random generation of labelled planar graphs. Its principles rely on Boltzmann samplers as recently developed by Duchon, Flajolet, Louchard, and Schaeffer. It combines the Boltzmann framework, a judicious use of rejection, a new combinatorial bijection found by Fusy, Poulalhon and Schaeffer, as well as a precise analytic description of the generating functions counting planar graphs, which was recently obtained by Giménez and Noy. This gives rise to an extremely efficient algorithm for the random generation of planar graphs. There is a preprocessing step of some fixed small cost. Then, for each generation, the time complexity is quadratic for exact-size uniform sampling and linear for approximate-size sampling. This greatly improves on the best previously known time complexity for exact-size uniform sampling of planar graphs with n vertices, which was a little over $\mathcal{O}(n^7)$.

[DMTCS-AD0113] Danièle Gardy and Alan Woods. And/or tree probabilities of boolean functions. In Conrado Martínez, editor, *2005 International Conference on Analysis of Algorithms*, volume AD of *DMTCS Proceedings*, pages 139–146. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAD0113.abs.html

We consider two probability distributions on Boolean functions defined in terms of their representations by *and/or* trees (or formulas). The relationships between them, and connections with the complexity of the function, are studied. New and improved bounds on these probabilities are given for a wide class of functions, with special attention being paid to the constant function *True* and read-once functions in a fixed number of variables.

[DMTCS-AD0114] Omer Giménez and Marc Noy. The number of planar graphs and properties of random planar graphs. In Conrado Martínez, editor, *2005 International Conference on Analysis of Algorithms*, volume AD of *DMTCS Proceedings*, pages 147–156. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAD0114.abs.html

We show an asymptotic estimate for the number of labelled planar graphs on n vertices. We also find limit laws for the number of edges, the number of connected components, and other parameters in random planar graphs.

[DMTCS-AD0115] Frédéric Giroire. Order statistics and estimating cardinalities of massive data sets. In Conrado Martínez, editor, *2005 International Conference on Analysis of Algorithms*, volume AD of *DMTCS Proceedings*, pages 157–166. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAD0115.abs.html

We introduce a new class of algorithms to estimate the cardinality of very large multisets using constant memory and doing only one pass on the data. It is based on order statistics rather that on bit patterns in binary representations of numbers. We analyse three families of estimators. They attain a standard error of $1/\sqrt{M}$ using M units of storage, which places them in the same class as the best known algorithms so far. They have a very simple internal loop, which gives them an advantage in term of processing speed. The algorithms are validated on internet traffic traces.

[DMTCS-AD0116] Bernhard Gittenberger. The profile of unlabeled trees. In Conrado Martínez, editor, *2005 International Conference on Analysis of Algorithms*, volume AD of *DMTCS Proceedings*, pages 167–172. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAD0116.abs.html

We consider the number of nodes in the levels of unlabeled rooted random trees and show that the joint distribution of several level sizes (where the level number is scaled by $\sqrt{n}$) weakly converges to the distribution of the local time of a Brownian excursion evaluated at the times corresponding to the level numbers. This extends existing results for simply generated trees and forests to the case of unlabeled rooted trees.

[DMTCS-AD0117] Bernhard Gittenberger and Alois Panholzer. Some results for monotonically labelled simply generated trees. In Conrado Martínez, editor, *2005 International Conference on Analysis of Algorithms*, volume AD of *DMTCS Proceedings*, pages 173–180. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAD0117.abs.html

We consider simply generated trees, where the nodes are equipped with weakly monotone labellings with elements of $\{1, 2, \ldots, r\}$, for r fixed. These tree families were introduced in [ProUrb1983] and studied further in [Kir1984], [Bli1987], and [MorPro2005]. Here we give distributional results for several tree statistics (the depth of a random node, the ancestor-tree size and the Steiner-distance of p randomly chosen nodes, the height of the j-st leaf, and the number of nodes with label l), which extend the existing results and also contain the corresponding results for unlabelled simply generated trees as the special case $r = 1$.

[DMTCS-AD0118] Rudolf Grübel. A hooray for poisson approximation. In Conrado Martínez, editor, *2005 International Conference on Analysis of Algorithms*, volume AD of *DMTCS Proceedings*, pages 181–192. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAD0118.abs.html

We give several examples for Poisson approximation of quantities of interest in the analysis of algorithms: the distribution of node depth in a binary search tree, the distribution of the number of losers in an election algorithm and the discounted profile of a binary search tree. A simple and well-known upper bound for the total variation distance between the distribution of a sum of independent Bernoulli variables and the Poisson distribution with the same mean turns out to be very useful in all three cases.

[DMTCS-AD0119] Hsien-Kuei Hwang. Profiles of random trees: plane-oriented recursive trees. In Conrado Martínez, editor, *2005 International Conference on Analysis of Algorithms*, volume AD of *DMTCS Proceedings*, pages 193–200. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAD0119.abs.html

We summarize several limit results for the profile of random plane-oriented recursive trees. These include the limit distribution of the normalized profile, asymptotic bimodality of the variance, asymptotic approximations of the expected width and the correlation coefficients of two level sizes. We also unveil an unexpected connection between the profile of plane-oriented recursive trees (with logarithmic height) and that of random binary trees (with height proportional to the square root of tree size).

[DMTCS-AD0120] Predrag R. Jelenković, Xiaozhu Kang, and Ana Radovanović. Near optimality of the discrete persistent access caching algorithm. In Conrado Martínez, editor, *2005 International Conference on Analysis of Algorithms*, volume AD of *DMTCS Proceedings*, pages 201–222. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAD0120.abs.html

Renewed interest in caching techniques stems from their application to improving the performance of the World Wide Web, where storing popular documents in proxy caches closer to end-users can significantly reduce the document download latency and overall network congestion. Rules used to update the collection of frequently accessed documents inside a cache are referred to as cache replacement algorithms. Due to many different factors that influence the Web performance, the most desirable attributes of a cache replacement scheme are low complexity and high adaptability to variability in Web access patterns. These properties are primarily the reason why most of the practical Web caching algorithms are based on the easily implemented Least-Recently-Used (LRU) cache replacement heuristic. In our recent paper [JERA04tr], we introduce a new algorithm, termed Persistent Access Caching (PAC), that, in addition to desirable low complexity and adaptability, somewhat surprisingly achieves nearly optimal performance for the independent reference model and generalized Zipf's law request probabilities. Two drawbacks of the PAC algorithm are its dependence on the request arrival times and variable storage requirements. In this paper, we resolve these problems by introducing a discrete version of the PAC policy (DPAC) that, after a cache miss, places the requested document in the cache only if it is requested at least k times among the last m, $m \geq k$, requests. However, from a mathematical perspective, due to the inherent coupling of the replacement decisions for different documents, the DPAC algorithm is considerably harder to analyze than the original PAC policy. In this regard, we develop a new analytical technique for estimating the performance of the DPAC rule. Using our analysis, we show that this algorithm is close to optimal even for small values of k and m, and, therefore, adds negligible additional storage and processing complexity in comparison to the ordinary LRU policy.

[DMTCS-AD0121] Gerard Kok. Pattern distribution in various types of random trees. In Conrado Martínez, editor, *2005 International Conference on Analysis of Algorithms*, volume AD of *DMTCS Proceedings*, pages 223–230. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAD0121.abs.html

Let T_n denote the set of unrooted unlabeled trees of size n and let M_k be a particular (finite) tree. Assuming that every tree of T_n is equally likely, it is shown that the number of occurrences X_n of M_k as an induced sub-tree satisfies $EX_n \sim \mu n$ and $VarX_n \sim \sigma^2 n$ for some (computable) constants $\mu > 0$ and $\sigma \geq 0$. Furthermore, if $\sigma > 0$ then $(X_n - EX_n)/\sqrt{VarX_n}$ converges to a limiting distribution with density $(A + Bt^2)e^{-Ct^2}$ for some constants A, B, C. However, in all cases in which we were able to calculate these constants, we obtained $B = 0$ and thus a normal distribution. Further, if we consider planted or rooted trees instead of T_n then the limiting distribution is always normal. Similar results can be proved for planar, labeled and simply generated trees.

[DMTCS-AD0122] Guy Louchard, Helmut Prodinger, and Mark Daniel Ward. The number of distinct values of some multiplicity in sequences of geometrically distributed random variables. In Conrado Martínez, editor, *2005 International Conference on Analysis of Algorithms*, volume AD of *DMTCS Proceedings*, pages 231–256. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAD0122.abs.html

We consider a sequence of n geometric random variables and interpret the outcome as an urn model. For a given parameter m, we treat several parameters like what is the largest urn containing at least (or exactly) m balls, or how many urns contain at least m balls, etc. Many of these questions have their origin in some computer science problems. Identifying the underlying distributions as (variations of) the extreme value distribution, we are able to derive asymptotic equivalents for all (centered or uncentered) moments in a fairly automatic way.

[DMTCS-AD0123] Pierre Nicodème. Average profiles, from tries to suffix-trees. In Conrado Martínez, editor, *2005 International Conference on Analysis of Algorithms*, volume AD of *DMTCS Proceedings*, pages 257–266. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAD0123.abs.html

We build upon previous work of [Fayj04] and [ParSzp05] to study asymptotically the average internal profile of tries and of suffix-trees. The binary keys and the strings are built from a Bernoulli source (p, q). We consider the average number $p_{k,P}(\nu)$ of internal nodes at depth k of a trie whose number of input keys follows a Poisson law of parameter ν. The Mellin transform of the corresponding bivariate generating function has a major singularity at the origin, which implies a phase reversal for the saturation rate $p_{k,P}(\nu)/2^k$ as k reaches the value $2log(\nu)/(log(1/p) + log(1/q))$. We prove that the asymptotic average profiles of random tries and suffix-trees are mostly similar, up to second order terms, a fact that has been experimentally observed in [Nic03]; the proof follows from comparisons to the profile of tries in the Poisson model.

[DMTCS-AD0124] Gahyun Park and Wojciech Szpankowski. Analysis of biclusters with applications to gene expression data. In Conrado Martínez, editor, *2005 International Conference on Analysis of Algorithms*, volume AD of *DMTCS Proceedings*, pages 267–274. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAD0124.abs.html

For a given matrix of size nm over a finite alphabet A, a bicluster is a submatrix composed of selected columns and rows satisfying a certain property. In microarrays analysis one searches for largest biclusters in which selected rows constitute the same string (pattern); in another formulation of the problem one tries to find a maximally dense submatrix. In a conceptually similar problem, namely the bipartite clique problem on graphs, one looks for the largest binary submatrix with all '1'. In this paper, we assume that the original matrix is generated by a memoryless source over a finite alphabet A. We first consider the case where the selected biclusters are square submatrices and prove that with high probability (whp) the largest (square) bicluster having the same row-pattern is of size $log_Q^2 nm$ where Q^{-1} is the (largest) probability of a symbol. We observe, however, that when we consider *any* submatrices (not just *square* submatrices), then the largest area of a bicluster jumps to An (whp) where A is an explicitly computable constant. These findings complete some recent results concerning maximal biclusters and maximum balanced bicliques for random bipartite graphs.

[DMTCS-AD0125] Nicolas Pouyanne. Classification of large pólya-eggenberger urns with regard to their asymptotics. In Conrado Martínez, editor, *2005 International Conference on Analysis of Algorithms*, volume AD of *DMTCS Proceedings*, pages 275–286. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAD0125.abs.html

This article deals with Pólya generalized urn models with constant balance in any dimension. It is based on the algebraic approach of [AlgApproach] and classifies urns having "large" eigenvalues in five classes, depending on their almost sure asymptotics. These classes are described in terms of the spectrum of the urn's replacement matrix and examples of each case are treated. We study the cases of so-called cyclic urns in any dimension and m-ary search trees for $m \geq 27$.

[DMTCS-AD0126] Hadas Shachnai and Lisa Zhang. The master ring problem. In Conrado Martínez, editor, *2005 International Conference on Analysis of Algorithms*, volume AD of *DMTCS Proceedings*, pages 287–296. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAD0126.abs.html

We consider the *master ring problem (MRP)* which often arises in optical network design. Given a network which consists of a collection of interconnected rings $R_1, \ldots, R_K$, with $n_1, \ldots, n_K$ distinct nodes, respectively, we need to find an ordering of the nodes in the network that respects the ordering of every individual ring, if one exists. Our main result is an exact algorithm for MRP whose running time approaches $Q \cdot \prod_{k=1}^{K}(n_k/\sqrt{2})$ for some polynomial Q, as the n_k values become large. For the *ring clearance problem*, a special case of practical interest, our algorithm achieves this running time for rings of *any* size $n_k \geq 2$. This yields the first nontrivial improvement, by factor of $(2\sqrt{2})^K \approx (2.82)^K$, over the running time of the naive algorithm, which exhaustively enumerates all $\prod_{k=1}^{K}(2n_k)$ possible solutions.

[DMTCS-AD0127] Alfredo Viola. Distributional analysis of robin hood linear probing hashing with buckets. In Conrado Martínez, editor, *2005 International Conference on Analysis of Algorithms*, volume AD of *DMTCS Proceedings*, pages 297–306. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAD0127.abs.html

This paper presents the first distributional analysis of a linear probing hashing scheme with buckets of size b. The exact distribution of the cost of successful searches for a $b\alpha$-full table is obtained, and moments and asymptotic results are derived. With the use of the Poisson transform distributional results are also obtained for tables of size m and n elements. A key element in the analysis is the use of a new family of numbers that satisfies a recurrence resembling that of the Bernoulli numbers. These numbers may prove helpful in studying recurrences involving truncated generating functions, as well as in other problems related with buckets.

[DMTCS-AD0128] Mark Daniel Ward and Wojciech Szpankowski. Analysis of the multiplicity matching parameter in suffix trees. In Conrado Martínez, editor, *2005 International Conference on Analysis of Algorithms*, volume AD of *DMTCS Proceedings*, pages 307–322. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAD0128.abs.html

In a suffix tree, the multiplicity matching parameter (MMP) M_n is the number of leaves in the subtree rooted at the branching point of the $(n+1)$st insertion. Equivalently, the MMP is the number of pointers into the database in the Lempel-Ziv '77 data compression algorithm. We prove that the MMP asymptotically follows the logarithmic series distribution plus some fluctuations. In the proof we compare the distribution of the MMP in suffix trees to its distribution in tries built over independent strings. Our results are derived by both probabilistic and analytic techniques of the analysis of algorithms. In particular, we utilize combinatorics on words, bivariate generating functions, pattern matching, recurrence relations, analytical poissonization and depoissonization, the Mellin transform, and complex analysis.

[DMTCS-AD0129] Mark C. Wilson. Asymptotics of riordan arrays. In Conrado Martínez, editor, *2005 International Conference on Analysis of Algorithms*, volume AD of *DMTCS Proceedings*, pages 323–334. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAD0129.abs.html

The machinery of Riordan arrays has been used recently by several authors. We show how meromorphic singularity analysis can be used to provide uniform bivariate asymptotic expansions, in the central regime, for a generalization of these arrays. We show how to do this systematically, for various descriptions of the array. Several examples from recent literature are given.

[DMTCS-AD0130] Daniel Berend, Ephraim Korach, and Shira Zucker. Two-anticoloring of planar and related graphs. In Conrado Martínez, editor, *2005 International Conference on Analysis of Algorithms*, volume AD of *DMTCS Proceedings*, pages 335–342. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAD0130.abs.html

An *anticoloring* of a graph is a coloring of some of the vertices, such that no two adjacent vertices are colored in distinct colors. We deal with the anticoloring problem with two colors for planar graphs, and, using Lipton and Tarjan's separation algorithm, provide an algorithm with some bound on the error. In the particular cases of graphs which are strong products of two paths or two cycles, we provide an explicit optimal solution.

[DMTCS-AD0131] Charlotte Brennan and Arnold Knopfmacher. The distribution of ascents of size d or more in samples of geometric random variables. In Conrado Martínez, editor, *2005 International Conference on Analysis of Algorithms*, volume AD of *DMTCS Proceedings*, pages 343–352. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAD0131.abs.html

We consider words or strings of characters $a_1a_2a_3\cdots a_n$ of length n, where the letters $a_i \in \mathbb{Z}$ are independently generated with a geometric probability $\mathbb{P}\{X=k\} = pq^{k-1}$ where $p+q=1$.
Let d be a fixed nonnegative integer. We say that we have an ascent of size d or more if $a_{i+1} \geq a_i + d$. We determine the mean, variance and limiting distribution of the number of ascents of size d or more in a random geometrically distributed word.

[DMTCS-AD0132] Amr Elmasry. Distribution-sensitive set multi-partitioning. In Conrado Martínez, editor, *2005 International Conference on Analysis of Algorithms*, volume AD of *DMTCS Proceedings*, pages 353–356. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAD0132.abs.html

Given a set *S* with real-valued members, associated with each member one of two possible types; a multi-partitioning of *S* is a sequence of the members of *S* such that if $x, y \in S$ have different types and $x < y$, x precedes y in the multi-partitioning of *S*. We give two distribution-sensitive algorithms for the set multi-partitioning problem and a matching lower bound in the algebraic decision-tree model. One of the two algorithms can be made stable and can be implemented in place. We also give an output-sensitive algorithm for the problem.

[DMTCS-AD0133] László Györfi and Sándor Győri. Analysis of tree algorithm for collision resolution. In Conrado Martínez, editor, *2005 International Conference on Analysis of Algorithms*, volume AD of *DMTCS Proceedings*, pages 357–364. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAD0133.abs.html

For the tree algorithm introduced by [Cap79] and [TsMi78] let L_N denote the expected collision resolution time given the collision multiplicity N. If $L(z)$ stands for the Poisson transform of L_N, then we show that

$$L_N - L(N) \simeq 1.29 \cdot 10^{-4} \cos(2\pi \log_2 N + 0.698).$$

[DMTCS-AD0134] Philippe Jacquet, Amina Meraihi Naimi, and Georgios Rodolakis. Performance of binary exponential backoff csma in wifi and optimal routing in mobile ad hoc networks. In Conrado Martínez, editor, *2005 International Conference on Analysis of Algorithms*, volume AD of *DMTCS Proceedings*, pages 365–370. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAD0134.abs.html

In this paper we show that the CSMA IEEE 802.11 protocol (Wifi) provides packet access delays asymptotics in power law. This very feature allows us to specify optimal routing via polynomial algorithm while the general case is NP-hard.

[DMTCS-AD0135] Shuji Kijima and Tomomi Matsui. Rapidly mixing chain and perfect sampler for logarithmic separable concave distributions on simplex. In Conrado Martínez, editor, *2005 International Conference on Analysis of Algorithms*, volume AD of *DMTCS Proceedings*, pages 371–382. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAD0135.abs.html

In this paper, we are concerned with random sampling of an n dimensional integral point on an $(n-1)$ dimensional simplex according to a multivariate discrete distribution. We employ sampling via Markov chain and propose two "hit-and-run" chains, one is for approximate sampling and the other is for perfect sampling. We introduce an idea of *alternating inequalities* and show that a *logarithmic separable concave* function satisfies the alternating inequalities. If a probability function satisfies alternating inequalities, then our chain for approximate sampling mixes in $O(n^2 ln(K\varepsilon^{-1}))$, namely $(1/2)n(n-1)ln(K\varepsilon^{-1})$, where K is the side length of the simplex and ε $(0 < \varepsilon < 1)$ is an error rate. On the same condition, we design another chain and a perfect sampler based on monotone CFTP (Coupling from the Past). We discuss a condition that the expected number of total transitions of the chain in the perfect sampler is bounded by $O(n^3 ln(Kn))$.

[DMTCS-AD0136] D. Merlini, R. Sprugnoli, and M. C. Verri. Human and constructive proof of combinatorial identities: an example from romik. In Conrado Martínez, editor, *2005 International Conference on Analysis of Algorithms*, volume AD of *DMTCS Proceedings*, pages 383–392. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAD0136.abs.html

It has become customary to prove binomial identities by means of the method for automated proofs as developed by Petkovšek, Wilf and Zeilberger [PWZ96]. In this paper, we wish to emphasize the role of "human" and constructive proofs in contrast with the somewhat lazy attitude of relaying on "automated" proofs. As a meaningful example, we consider the four formulas by Romik [Rom03], related to Motzkin and central trinomial numbers. We show that a proof of these identities can be obtained by using the method of coefficients, a human method only requiring hand computations.

[DMTCS-AD0137] Hiroyoshi Morita and Takahiro Ota. A tight upper bound on the size of the antidictionary of a binary string. In Conrado Martínez, editor, *2005 International Conference on Analysis of Algorithms*, volume AD of *DMTCS Proceedings*, pages 393–398. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAD0137.abs.html

A tight upper bound of the size of the antidictionary of a binary string is presented. And it is shown that the size of the antidictionary of a binary sting is always smaller than or equal to that of its dictionary. Moreover, an algorithm to reconstruct its dictionary from its antidictionary is given.

[DMTCS-AD0138] Boris Ryabko and Jaakko Astola. Application of data compression methods to hypothesis testing for ergodic and stationary processes. In Conrado Martínez, editor, *2005 International Conference on Analysis of Algorithms*, volume AD of *DMTCS Proceedings*, pages 399–408. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAD0138.abs.html

We show that data compression methods (or universal codes) can be applied for hypotheses testing in a framework of classical mathematical statistics. Namely, we describe tests, which are based on data compression methods, for the three following problems: i) identity testing, ii) testing for independence and iii) testing of serial independence for time series. Applying our method of identity testing to pseudorandom number generators, we obtained experimental results which show that the suggested tests are quite efficient.

[DMTCS-AD0139] Andreas Weiermann. Analytic combinatorics for a certain well-ordered class of iterated exponential terms. In Conrado Martínez, editor, *2005 International Conference on Analysis of Algorithms*, volume AD of *DMTCS Proceedings*, pages 409–416. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAD0139.abs.html

The aim of this paper is threefold: firstly, to explain a certain segment of ordinals in terms which are familiar to the analytic combinatorics community, secondly to state a great many of associated problems on resulting count functions and thirdly, to provide some weak asymptotic for the resulting count functions. We employ for simplicity Tauberian methods. The analytic combinatorics community is encouraged to provide (maybe in joint work) sharper results in future investigations.

[DMTCS-AE0101] Colin J. H. McDiarmid and Tobias Müller. Colouring random geometric graphs. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 1–4. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0101.abs.html

A random geometric graph G_n is obtained as follows. We take $X_1, X_2, \ldots, X_n \in \mathbb{R}^d$ at random (i.i.d. according to some probability distribution ν on $\mathbb{R}^d$). For $i \neq j$ we join X_i and X_j by an edge if $\|X_i - X_j\| < r(n)$. We study the properties of the chromatic number χ_n and clique number ω_n of this graph as n becomes large, where we assume that $r(n) \to 0$. We allow any choice ν that has a bounded density function and $\|.\|$ may be any norm on $\mathbb{R}^d$. Depending on the choice of $r(n)$, qualitatively different types of behaviour can be observed. We distinguish three main cases, in terms of the key quantity nr^d (which is a measure of the average degree). If $r(n)$ is such that $nr^d / \ln n \to 0$ as $n \to \infty$ then $\chi_n / \omega_n \to 1$ almost surely. If $nr^d / \ln n \to \infty$ then $\chi_n / \omega_n \to 1 / \delta$ almost surely, where δ is the (translational) *packing density* of the unit ball $B := \{x \in \mathbb{R}^d : \|x\| < 1\}$ (i.e. δ is the proportion of d-space that can be filled with disjoint translates of B). If $nr^d / \ln n \to t \in (0, \infty)$ then χ_n / ω_n tends almost surely to a constant that can be bounded in terms of δ and t. These results extend earlier work of McDiarmid and Penrose. The proofs in fact yield separate expressions for χ_n and ω_n. We are also able to prove a conjecture by Penrose. This states that when $nr^d / \ln n \to 0$ then the clique number becomes focussed on two adjacent integers, meaning that there exists a sequence $k(n)$ such that $P(\omega_n \in \{k(n), k(n)+1\}) \to 1$ as $n \to \infty$. The analogous result holds for the chromatic number (and for the maximum degree, as was already shown by Penrose in the uniform case).

[DMTCS-AE0102] Isolde Adler, Georg Gottlob, and Martin Grohe. Hypertree-width and related hypergraph invariants. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS*

Proceedings, pages 5–10. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0102.abs.html

We study the notion of hypertree-width of hypergraphs. We prove that, up to a constant factor, hypertree-width is the same as a number of other hypergraph invariants that resemble graph invariants such as bramble-number, branch-width, linkedness, and the minimum number of cops required to win Seymour and Thomas's robber and cops game.

[DMTCS-AE0103] Kazuyuki Amano and Jun Tarui. Monotone boolean functions with s zeros farthest from threshold functions. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 11–16. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0103.abs.html

Let T_t denote the t-threshold function on the n-cube: $T_t(x) = 1$ if $|\{i : x_i = 1\}| \geq t$, and 0 otherwise. Define the distance between Boolean functions g and h, $d(g, h)$, to be the number of points on which g and h disagree. We consider the following extremal problem: Over a monotone Boolean function g on the n-cube with s zeros, what is the maximum of $d(g, T_t)$? We show that the following monotone function p_s maximizes the distance: For $x \in \{0, 1\}^n$, $p_s(x) = 0$ if and only if $N(x) < s$, where $N(x)$ is the integer whose n-bit binary representation is x. Our result generalizes the previous work for the case $t = \lceil n/2 \rceil$ and $s = 2^{n-1}$ by Blum, Burch, and Langford [BBL98-FOCS98], who considered the problem to analyze the behavior of a learning algorithm for monotone Boolean functions, and the previous work for the same t and s by Amano and Maruoka [AM02-ALT02].

[DMTCS-AE0104] Richard P. Anstee and Peter Keevash. Pairwise intersections and forbidden configurations. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 17–20. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0104.abs.html

Let $f_m(a, b, c, d)$ denote the maximum size of a family $\mathcal{F}$ of subsets of an m-element set for which there is no pair of subsets $A, B \in \mathcal{F}$ with $|A \cap B| \geq a$, $|A \cap <bar> B </bar>| \geq b$, $|A \cap <bar> B </bar>| \geq c$, and $|<bar> A </bar> \cap <bar> B </bar>| \geq d$.
By symmetry we can assume $a \geq d$ and $b \geq c$. We show that $f_m(a, b, c, d)$ is $\Theta(m^{a+b-1})$ if either $b > c$ or $a, b \geq 1$. We also show that $f_m(0, b, b, 0)$ is $\Theta(m^b)$ and $f_m(a, 0, 0, d)$ is $\Theta(m^a)$. This can be viewed as a result concerning forbidden configurations and is further evidence for a conjecture of Anstee and Sali. Our key tool is a strong stability version of the Complete Intersection Theorem of Ahlswede and Khachatrian, which is of independent interest.

[DMTCS-AE0105] David Défossez. A sufficient condition for bicolorable hypergraphs. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 21–24. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0105.abs.html

In this note we prove Sterboul's conjecture, that provides a sufficient condition for the bicolorability of hypergraphs.

[DMTCS-AE0106] Oleg Pikhurko, Joel Spencer, and Oleg Verbitsky. Decomposable graphs and definitions with no quantifier alternation. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 25–30. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0106.abs.html

Let $D(G)$ be the minimum quantifier depth of a first order sentence Φ that defines a graph G up to isomorphism in terms of the adjacency and the equality relations. Let $D_0(G)$ be a variant of $D(G)$ where we do not allow quantifier alternations in Φ. Using large graphs decomposable in complement-connected components by a short sequence of serial and parallel decompositions, we show examples of G on n vertices with $D_0(G) \leq 2\log^* n + O(1)$. On the other hand, we prove a lower bound $D_0(G) \geq \log^* n - \log^* \log^* n - O(1)$ for all G. Here $\log^* n$ is equal to the minimum number of iterations of the binary logarithm needed to bring n below 1.

[DMTCS-AE0107] Martin Kutz. Weak positional games on hypergraphs. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 31–36. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0107.abs.html

In a weak positional game, two players, Maker and Breaker, alternately claim vertices of a hypergraph until either Maker wins by getting a complete edge or all vertices are taken without this happening, a Breaker win. For the class of almost-disjoint hypergraphs of rank three (edges with up to three vertices only and edge-intersections on at most one vertex) we show how to find optimal strategies in polynomial time. Our result is based on a new type of decomposition theorem which might lead to a better understanding of weak positional games in general.

[DMTCS-AE0108] Christian Bey. Quadratic lym inequalities. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 37–40. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0108.abs.html

Let $\mathcal{F} \subseteq 2^{[n]}$ be a intersecting Sperner family (i.e. $A \not\subset B$, $A \cap B \neq \emptyset$ for all $A, B \in \mathcal{F}$) with profile vector $(f_i)_{i=0\ldots n}$ (i.e. $f_i = |\mathcal{F} \cap \binom{[n]}{i}|$). We present quadratic inequalities in the f_i's which sharpen the previously known linear LYM-type inequalities.

[DMTCS-AE0109] Peter Bella, Daniel Král', Bojan Mohar, and Katarína Quittnerová. Labeling planar graphs with a condition at distance two. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb*

'05), volume AE of *DMTCS Proceedings*, pages 41–44. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0109.abs.html

An $L(2,1)$-labeling of a graph is a mapping $c : V(G) \to \{0, \ldots, K\}$ such that the labels assigned to neighboring vertices differ by at least 2 and the labels of vertices at distance two are different. Griggs and Yeh [SIAM J. Discrete Math. 5 (1992), 586–595] conjectured that every graph G with maximum degree Δ has an $L(2,1)$-labeling with $K \leq \Delta^2$. We verify the conjecture for planar graphs with maximum degree $\Delta \neq 3$.

[DMTCS-AE0110] Bruce Reed and David R. Wood. Fast separation in a graph with an excluded minor. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 45–50. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0110.abs.html

Let G be an n-vertex m-edge graph with weighted vertices. A pair of vertex sets $A, B \subseteq V(G)$ is a *2/3-separation* of *order* $|A \cap B|$ if $A \cup B = V(G)$, there is no edge between AB and BA, and both AB and BA have weight at most $2/3$ the total weight of G. Let $\ell \in \mathbb{Z}+$ be fixed. Alon, Seymour and Thomas [*J. Amer. Math. Soc.* 1990] presented an algorithm that in $\mathcal{O}(n^{1/2}m)$ time, either outputs a K_ℓ-minor of G, or a separation of G of order $\mathcal{O}(n^{1/2})$. Whether there is a $\mathcal{O}(n+m)$ time algorithm for this theorem was left as open problem. In this paper, we obtain a $\mathcal{O}(n+m)$ time algorithm at the expense of $\mathcal{O}(n^{2/3})$ separator. Moreover, our algorithm exhibits a tradeoff between running time and the order of the separator. In particular, for any given $\epsilon \in [0, 1/2]$, our algorithm either outputs a K_ℓ-minor of G, or a separation of G with order $\mathcal{O}(n^{(2-\epsilon)/3})$ in $\mathcal{O}(n^{1+\epsilon}+m)$ time.

[DMTCS-AE0111] Vladimir Deineko, Peter Jonsson, Mikael Klasson, and Andrei Krokhin. Supermodularity on chains and complexity of maximum constraint satisfaction. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 51–56. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0111.abs.html

In the maximum constraint satisfaction problem (Max CSP), one is given a finite collection of (possibly weighted) constraints on overlapping sets of variables, and the goal is to assign values from a given finite domain to the variables so as to maximise the number (or the total weight) of satisfied constraints. This problem is NP-hard in general so it is natural to study how restricting the allowed types of constraints affects the complexity of the problem. In this paper, we show that any Max CSP problem with a finite set of allowed constraint types, which includes all constants (i.e. constraints of the form $x = a$), is either solvable in polynomial time or is NP-complete. Moreover, we present a simple description of all polynomial-time solvable cases of our problem. This description uses the well-known combinatorial property of supermodularity.

[DMTCS-AE0112] Dan Romik. Permutations with short monotone subsequences. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 57–62. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0112.abs.html

We consider permutations of $1, 2, ..., n^2$ whose longest monotone subsequence is of length n and are therefore extremal for the Erdős-Szekeres Theorem. Such permutations correspond via the Robinson-Schensted correspondence to pairs of square nn Young tableaux. We show that all the bumping sequences are constant and therefore these permutations have a simple description in terms of the pair of square tableaux. We deduce a limit shape result for the plot of values of the typical such permutation, which in particular implies that the first value taken by such a permutation is with high probability $(1 + o(1))n^2/2$.

[DMTCS-AE0113] Tomasz Bartnicki, Jarosław Grytczuk, and Hal Kierstead. The game of arboricity. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 63–66. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0113.abs.html

Using a fixed set of colors C, Ann and Ben color the edges of a graph G so that no monochromatic cycle may appear. Ann wins if all edges of G have been colored, while Ben wins if completing a coloring is not possible. The minimum size of C for which Ann has a winning strategy is called the *game arboricity* of G, denoted by $A_g(G)$. We prove that $A_g(G) \leq 3k$ for any graph G of arboricity k, and that there are graphs such that $A_g(G) \geq 2k - 2$. The upper bound is achieved by a suitable version of the activation strategy, used earlier for the vertex coloring game. We also provide other strategie based on induction.

[DMTCS-AE0114] William Evans and Mohammad Ali Safari. Directed one-trees. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 67–72. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0114.abs.html

We identify the class of directed one-trees and prove the so-called min-max theorem for them. As a consequence, we establish the equality of directed tree-width and a new measure, d-width, on this class of graphs. In addition, we prove a property of all directed one-trees and use this property to create an $O(n^2)$ recognition algorithm and an $O(n^2)$ algorithm for solving the Hamiltonian cycle problem on directed one-trees.

[DMTCS-AE0115] Joshua Cooper, Benjamin Doerr, Joel Spencer, and Gábor Tardos. Deterministic random walks on the integers. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 73–76. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0115.abs.html

We analyze the one-dimensional version of Jim Propp's P-machine, a simple deterministic process that simulates a random walk on $\mathbb{Z}$. The "output" of the machine is astonishingly close to the expected behavior of a random walk, even on long intervals of space and time.

[DMTCS-AE0116] John Talbot. Chromatic turán problems and a new upper bound for the turán density of K_4^-. In Stefan Felsner, editor, *2005 European Conference on Combinatorics,*

Graph Theory and Applications (EuroComb '05), volume AE of *DMTCS Proceedings*, pages 77–80. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0116.abs.html

We consider a new type of extremal hypergraph problem: given an r-graph $\mathcal{F}$ and an integer $k \geq 2$ determine the maximum number of edges in an $\mathcal{F}$-free, k-colourable r-graph on n vertices. Our motivation for studying such problems is that it allows us to give a new upper bound for an old problem due to Turán. We show that a 3-graph in which any four vertices span at most two edges has density less than $33 / 100$, improving previous bounds of $1 / 3$ due to de Caen [deC], and $1 / 3 - 4.5305 \times 10^{-6}$ due to Mubayi [M].

[DMTCS-AE0117] Daniel Gonçalves. On the $L(p, 1)$-labelling of graphs. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 81–86. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0117.abs.html

In this paper we improve the best known bound for the $L(p, 1)$-labelling of graphs with given maximal degree.

[DMTCS-AE0118] Martin Charles Golumbic, Marina Lipshteyn, and Michal Stern. Representations of edge intersection graphs of paths in a tree. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 87–92. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0118.abs.html

Let $\mathcal{P}$ be a collection of nontrivial simple paths in a tree T. The edge intersection graph of $\mathcal{P}$, denoted by $EPT(\mathcal{P})$, has vertex set that corresponds to the members of $\mathcal{P}$, and two vertices are joined by an edge if the corresponding members of $\mathcal{P}$ share a common edge in T. An undirected graph G is called an edge intersection graph of paths in a tree, if $G = EPT(\mathcal{P})$ for some $\mathcal{P}$ and T. The EPT graphs are useful in network applications. Scheduling undirected calls in a tree or assigning wavelengths to virtual connections in an optical tree network are equivalent to coloring its EPT graph. It is known that recognition and coloring of EPT graphs are NP-complete problems. However, the EPT graphs restricted to host trees of vertex degree 3 are precisely the chordal EPT graphs, and therefore can be colored in polynomial time complexity. We prove a new analogous result that weakly chordal EPT graphs are precisely the EPT graphs with host tree restricted to degree 4. This also implies that the coloring of the edge intersection graph of paths in a degree 4 tree is polynomial. We raise a number of intriguing conjectures regarding related families of graphs.

[DMTCS-AE0119] Iliya Bouyukliev, Veerle Fack, and Joost Winne. Hadamard matrices of order 36. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 93–98. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0119.abs.html

Before this work, at least 762 inequivalent Hadamard matrices of order 36 were known. We found 7238 Hadamard matrices of order 36 and 522 inequivalent $[72, 36, 12]$ double-even self-dual codes which are obtained from all 2-$(35, 17, 8)$ designs with an automorphism of order 3 and 2 fixed points and blocks.

[DMTCS-AE0120] Louis Esperet, Mickaël Montassier, and André Raspaud. Linear choosability of graphs. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 99–104. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0120.abs.html

A proper vertex coloring of a non oriented graph $G = (V, E)$ is *linear* if the graph induced by the vertices of two color classes is a forest of paths. A graph G is L-list colorable if for a given list assignment $L = \{L(v) : v \in V\}$, there exists a proper coloring c of G such that $c(v) \in L(v)$ for all $v \in V$. If G is L-list colorable for every list assignment with $|L(v)| \geq k$ for all $v \in V$, then G is said k-choosable. A graph is said to be lineary k-choosable if the coloring obtained is linear. In this paper, we investigate the linear choosability of graphs for some families of graphs: graphs with small maximum degree, with given maximum average degree, planar graphs... Moreover, we prove that determining whether a bipartite subcubic planar graph is lineary 3-colorable is an NP-complete problem.

[DMTCS-AE0121] Michael J. Pelsmajer, Marcus Schaefer, and Daniel Štefankovič. Removing even crossings. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 105–110. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0121.abs.html

An edge in a drawing of a graph is called *even* if it intersects every other edge of the graph an even number of times. Pach and Tóth proved that a graph can always be redrawn such that its even edges are not involved in any intersections. We give a new, and significantly simpler, proof of a slightly stronger statement. We show two applications of this strengthened result: an easy proof of a theorem of Hanani and Tutte (not using Kuratowski's theorem), and the result that the odd crossing number of a graph equals the crossing number of the graph for values of at most 3. We begin with a disarmingly simple proof of a weak (but standard) version of the theorem by Hanani and Tutte.

[DMTCS-AE0122] Christian Deppe and Holger Schnettler. On the $3/4$-conjecture for fix-free codes. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 111–116. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0122.abs.html

In this paper we concern ourself with the question, whether there exists a fix-free code for a given sequence of codeword lengths. We focus mostly on results which shows the $3\,/\,4$-conjecture for special kinds of lengths sequences.

[DMTCS-AE0123] Richard Anstee, Balin Fleming, Zoltán Füredi, and Attila Sali. Color critical hypergraphs and forbidden configurations. In Stefan Felsner, editor, *2005 European*

Conference on Combinatorics, Graph Theory and Applications (EuroComb '05), volume AE of *DMTCS Proceedings*, pages 117–122. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0123.abs.html

The present paper connects sharpenings of Sauer's bound on forbidden configurations with color critical hypergraphs. We define a matrix to be *simple* if it is a (0,1)-matrix with no repeated columns. Let F be a kl (0,1)-matrix (the forbidden configuration). Assume A is an mn simple matrix which has no submatrix which is a row and column permutation of F. We define forb(m, F) as the best possible upper bound on n, for such a matrix A, which depends on m and F. It is known that forb$(m, F) = O(m^k)$ for any F, and Sauer's bond states that forb$(m, F) = O(m^{k-1})$ fore *simple* F. We give sufficient condition for non-simple F to have the same bound using linear algebra methods to prove a generalization of a result of Lovsz on color critical hypergraphs.

[DMTCS-AE0124] Drago Bokal, Gašper Fijavž, and Bojan Mohar. Minor-monotone crossing number. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 123–128. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0124.abs.html

The minor crossing number of a graph G, mcr(G), is defined as the minimum crossing number of all graphs that contain G as a minor. We present some basic properties of this new minor-monotone graph invariant. We give estimates on mcr for some important graph families using the topological structure of graphs satisfying mcr$(G)\leq k$.

[DMTCS-AE0125] Veerle Fack, Svetlana Topalova, and Joost Winne. On the enumeration of uniquely reducible double designs. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 129–132. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0125.abs.html

A double 2-(v,k,2λ) design is a design which is reducible into two 2-(v,k,λ) designs. It is called uniquely reducible if it has, up to equivalence, only one reduction. We present properties of uniquely reducible double designs which show that their total number can be determined if only the designs with non-trivial automorphisms are classified with respect to their automorphism group. As an application, after proving that a reducible 2-(21,5,2) design is uniquely reducible, we establish that the number of all reducible 2-(21,5,2) designs is 1 746 461 307.

[DMTCS-AE0126] Noga Alon and Jarosław Grytczuk. Nonrepetitive colorings of graphs. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 133–134. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0126.abs.html

A vertex coloring of a graph G is *k-nonrepetitive* if one cannot find a periodic sequence with k blocks on any simple path of G. The minimum number of colors needed for such coloring is denoted by $\pi_k(G)$. This idea combines graph colorings with Thue sequences introduced at the beginning of 20th century. In particular Thue proved that if G is a simple path of any length greater than 4 then $\pi_2(G) = 3$ and $\pi_3(G) = 2$. We investigate $\pi_k(G)$ for other classes of graphs. Particularly interesting open problem is to decide if there is, possibly huge, k such that $\pi_k(G)$ is bounded for planar graphs.

[DMTCS-AE0127] Paul Bonsma. A characterization of extremal graphs with no matching-cut. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 135–138. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0127.abs.html

A graph is called (matching-)immune if it has no edge cut that is also a matching. Farley and Proskurowski proved that for all immune graphs $G = (V, E)$, $|E| \geq \lceil 3(|V| - 1)/2 \rceil$, and constructed a large class of immune graphs that attain this lower bound for every value of $|V(G)|$, called ABC graphs. They conjectured that every immune graph that attains this lower bound is an ABC graph. We present a proof of this conjecture.

[DMTCS-AE0128] Gyula Pap. Packing non-returning A-paths algorithmically. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 139–144. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0128.abs.html

In this paper we present an algorithmic approach to packing A-paths. It is regarded as a generalization of Edmonds' matching algorithm, however there is the significant difference that here we do not build up any kind of alternating tree. Instead we use the so-called 3-way lemma, which either provides augmentation, or a dual, or a subgraph which can be used for contraction. The method works in the general setting of packing non-returning A-paths. It also implies an ear-decomposition of criticals, as a generalization of the odd ear-decomposition of factor-critical graph.

[DMTCS-AE0129] Éric Rémila. Structure of spaces of rhombus tilings in the lexicograhic case. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 145–150. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0129.abs.html

Rhombus tilings are tilings of zonotopes with rhombohedra. We study a class of *lexicographic* rhombus tilings of zonotopes, which are deduced from higher Bruhat orders relaxing the unitarity condition. Precisely, we fix a sequence $(v_1, v_2, \ldots, v_D)$ of vectors of $\mathbb{R}^d$ and a sequence $(m_1, m_2, \ldots, m_D)$ of positive integers. We assume (lexicographic hypothesis) that for each subsequence $(v_{i_1}, v_{i_2}, \ldots, v_{i_d})$ of length d, we have $det(v_{i_1}, v_{i_2}, \ldots, v_{i_d}) > 0$. The zonotope Z is the set $\{\sum \alpha_i v_i \ 0 \leq \alpha_i \leq m_i\}$. Each prototile used in a tiling of Z is a rhombohedron constructed from a subsequence of d vectors. We prove that the space of tilings of Z is a graded poset, with minimal and maximal element.

[DMTCS-AE0130] Andrew D. King, Bruce A. Reed, and Adrian R. Vetta. An upper bound for the chromatic number of line graphs. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 151–156. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0130.abs.html

It was conjectured by Reed [reed98conjecture] that for any graph G, the graph's chromatic number $\chi(G)$ is bounded above by $\lceil \Delta(G) + 1 + \omega(G) / 2 \rceil$, where $\Delta(G)$ and $\omega(G)$ are the maximum degree and clique number of G, respectively. In this paper we prove that this bound holds if G is the line graph of a multigraph. The proof yields a polynomial time algorithm that takes a line graph G and produces a colouring that achieves our bound.

[DMTCS-AE0131] Matěj Stehlík. Connected τ-critical hypergraphs of minimal size. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 157–160. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0131.abs.html

A hypergraph $\mathcal{H}$ is τ-critical if $\tau(\mathcal{H} - E) < \tau(\mathcal{H})$ for every edge $E \in \mathcal{H}$, where $\tau(\mathcal{H})$ denotes the transversal number of $\mathcal{H}$. It can be shown that a connected τ-critical hypergraph $\mathcal{H}$ has at least $2\tau(\mathcal{H}) - 1$ edges; this generalises a classical theorem of Gallai on χ-vertex-critical graphs with connected complements. In this paper we study connected τ-critical hypergraphs $\mathcal{H}$ with exactly $2\tau(\mathcal{H}) - 1$ edges. We prove that such hypergraphs have at least $2\tau(\mathcal{H}) - 1$ vertices, and characterise those with $2\tau(\mathcal{H}) - 1$ vertices using a directed odd ear decomposition of an associated digraph. Using Seymour's characterisation of χ-critical 3-chromatic square hypergraphs, we also show that a connected square hypergraph $\mathcal{H}$ with fewer than $2\tau(\mathcal{H})$ edges is τ-critical if and only if it is χ-critical 3-chromatic. Finally, we deduce some new results on χ-vertex-critical graphs with connected complements.

[DMTCS-AE0132] Francisco Javier Zaragoza Martínez. The windy postman problem on series-parallel graphs. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 161–166. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0132.abs.html

The *windy postman problem* is the NP-hard problem of finding the minimum cost of a tour traversing all edges of an undirected graph, where the cost of traversal of an edge depends on the direction. Given an undirected graph G, we consider the polyhedron $O(G)$ induced by the linear programming relaxation of a well-known integer programming formulation of the problem. We say that G is *windy postman perfect* if $O(G)$ is integral. There exists a polynomial-time algorithm, based on the ellipsoid method, to solve the windy postman problem for the class of windy postman perfect graphs. Eulerian graphs and trees are windy postman perfect. By considering a family of polyhedra related to $O(G)$, we prove that series-parallel graphs are windy postman perfect, therefore solving a conjecture of [Win1987a].

[DMTCS-AE0133] Gohar Kyureghyan. Crooked maps in finite fields. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 167–170. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0133.abs.html

We consider the maps $f : \mathbb{F}_{2^n} \to \mathbb{F}_{2^n}$ with the property that the set $\{f(x+a)+f(x) : x \in F_{2^n}\}$ is a hyperplane or a complement of hyperplane for every $a \in \mathbb{F}_{2^n}^*$. The main goal of the talk is to show that almost all maps $f(x) = \sum_{b\in B} c_b(x+b)^d$, where $B \subset \mathbb{F}_{2^n}$ and $\sum_{b\in B} c_b \neq 0$, are not of that type. In particular, the only such power maps have exponents $2^i + 2^j$ with $\gcd(n, i-j) = 1$. We give also a geometrical characterization of this maps.

[DMTCS-AE0134] Javier Barajas and Oriol Serra. Distance graphs with maximum chromatic number. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 171–174. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0134.abs.html

Let D be a finite set of integers. The distance graph $G(D)$ has the set of integers as vertices and two vertices at distance $d \in D$ are adjacent in $G(D)$. A conjecture of Xuding Zhu states that if the chromatic number of $G(D)$ achieves its maximum value $|D|+1$ then the graph has a clique of order $|D|$. We prove that the chromatic number of a distance graph with $D = \{a, b, c, d\}$ is five if and only if either $D = \{1, 2, 3, 4k\}$ or $D = \{a, b, a+b, a+2b\}$ with $a \equiv 0 \bmod 2$ and $b \equiv 1 \bmod 2$. This confirms Zhu's conjecture for $|D| = 4$.

[DMTCS-AE0135] Márton Makai. Matroid matching with dilworth truncation. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 175–180. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0135.abs.html

Let $H = (V, E)$ be a hypergraph and let $k \geq 1$ and $l \geq 0$ be fixed integers. Let $\mathcal{M}$ be the matroid with ground-set E s.t. a set $F \subseteq E$ is independent if and only if each $X \subseteq V$ with $k|X| - l \geq 0$ spans at most $k|X| - l$ hyperedges of F. We prove that if H is dense enough, then $\mathcal{M}$ satisfies the double circuit property, thus the min-max formula of Dress and Lovász on the maximum matroid matching holds for $\mathcal{M}$. Our result implies the Berge-Tutte formula on the maximum matching of graphs ($k = 1$, $l = 0$), generalizes Lovász' graphic matroid (cycle matroid) matching formula to hypergraphs ($k = l = 1$) and gives a min-max formula for the maximum matroid matching in the 2-dimensional rigidity matroid ($k = 2$, $l = 3$).

[DMTCS-AE0136] Audrey Lee and Ileana Streinu. Pebble game algorithms and (k, l)-sparse graphs. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 181–186. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0136.abs.html

A multi-graph G on n vertices is (k,l)-sparse if every subset of $n' \leq n$ vertices spans at most $kn' - l$ edges, $0 \leq l < 2k$. G is *tight* if, in addition, it has exactly $kn - l$ edges. We characterize (k,l)-sparse graphs via a family of simple, elegant and efficient algorithms called the (k,l)-pebble games. As applications, we use the pebble games for computing *components* (maximal tight subgraphs) in sparse graphs, to obtain inductive (Henneberg) constructions, and, when $l = k$, edge-disjoint tree decompositions.

[DMTCS-AE0137] Tamon Stephen. On the grone-merris conjecture. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 187–192. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0137.abs.html

Grone and Merris [GM94] conjectured that the Laplacian spectrum of a graph is majorized by its conjugate vertex degree sequence. We prove that this conjecture holds for a class of graphs including trees. We also show that this conjecture and its generalization to graphs with Dirichlet boundary conditions are equivalent.

[DMTCS-AE0138] Ross J. Kang, Tobias Müller, and Jean-Sébastien Sereni. Improper colouring of (random) unit disk graphs. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 193–198. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0138.abs.html

For any graph G, the *k-improper chromatic number* $\chi^k(G)$ is the smallest number of colours used in a colouring of G such that each colour class induces a subgraph of maximum degree k. We investigate the ratio of the k-improper chromatic number to the clique number for unit disk graphs and random unit disk graphs to extend results of [McRe99, McD03] (where they considered only proper colouring).

[DMTCS-AE0139] Daniela Kühn and Deryk Osthus. K_ℓ^--factors in graphs. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 199–202. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0139.abs.html

Let K_ℓ^- denote the graph obtained from K_ℓ by deleting one edge. We show that for every $\gamma > 0$ and every integer $\ell \geq 4$ there exists an integer $n_0 = n_0(\gamma, \ell)$ such that every graph G whose order $n \geq n_0$ is divisible by ℓ and whose minimum degree is at least $(\ell^2 - 3\ell + 1 \,/\, \ell(\ell-2) + \gamma)n$ contains a K_ℓ^--factor, i.e. a collection of disjoint copies of K_ℓ^- which covers all vertices of G. This is best possible up to the error term γn and yields an approximate solution to a conjecture of Kawarabayashi.

[DMTCS-AE0140] Kathie Cameron and Jack Edmonds. Finding a strong stable set or a meyniel obstruction in any graph. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS*

Proceedings, pages 203–206. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0140.abs.html

A strong stable set in a graph G is a stable set that contains a vertex of every maximal clique of G. A Meyniel obstruction is an odd circuit with at least five vertices and at most one chord. Given a graph G and a vertex v of G, we give a polytime algorithm to find either a strong stable set containing v or a Meyniel obstruction in G. This can then be used to find in any graph, a clique and colouring of the same size or a Meyniel obstruction.

[DMTCS-AE0141] Kenji Kashiwabara and Masataka Nakamura. Nbc complexes of convex geometries. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 207–212. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0141.abs.html

We introduce a notion of a *broken circuit* and an *NBC complex* for an (abstract) convex geometry. Based on these definitions, we shall show the analogues of the Whitney-Rota's formula and Brylawski's decomposition theorem for broken circuit complexes on matroids for convex geometries. We also present an Orlik-Solomon type algebra on a convex geometry, and show the NBC generating theorem. This note is on the same line as the studies in [nakamura03a, okamoto-nakamura, nakamura].

[DMTCS-AE0142] Adrian Kosowski, Michał Małafiejski, and Paweł Żyliński. Packing three-vertex paths in a subcubic graph. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 213–218. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0142.abs.html

In our paper we consider the P_3-packing problem in subcubic graphs of different connectivity, improving earlier results of Kelmans and Mubayi [KM04]. We show that there exists a P_3-packing of at least $\lceil 3n/4 \rceil$ vertices in any connected subcubic graph of order $n > 5$ and minimum vertex degree $\delta \geq 2$, and that this bound is tight. The proof is constructive and implied by a linear-time algorithm. We use this result to show that any 2-connected cubic graph of order $n > 8$ has a P_3-packing of at least $\lceil 7n/9 \rceil$ vertices.

[DMTCS-AE0143] Anna Lladó. Largest cliques in connected supermagic graphs. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 219–222. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0143.abs.html

A graph $G = (V, E)$ is said to be *magic* if there exists an integer labeling $f : V \cup E \rightarrow [1, |V \cup E|]$ such that $f(x) + f(y) + f(xy)$ is constant for all edges $xy \in E$. Enomoto, Masuda and Nakamigawa proved that there are magic graphs of order at most $3n^2 + o(n^2)$ which contain a complete graph of order n. Bounds on Sidon sets show that the order of such a graph is at least $n^2 + o(n^2)$. We close the gap between those two bounds by showing that, for any given graph H of order n, there are connected magic graphs of order $n^2 + o(n^2)$ containing H as an induced subgraph. Moreover it can be required that the graph admits a supermagic labelling f, which satisfies the additional condition $f(V) = [1, |V|]$.

[DMTCS-AE0144] Anthony Bonato and Jeannette Janssen. Infinite limits and folding. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 223–228. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0144.abs.html

We study infinite limits of graphs generated by the duplication model for biological networks. We prove that with probability 1, the sole nontrivial connected component of the limits is unique up to isomorphism. We describe certain infinite deterministic graphs which arise naturally from the model. We characterize the isomorphism type and induced subgraph structure of these infinite graphs using the notion of dismantlability from the theory of vertex pursuit games, and graph homomorphisms.

[DMTCS-AE0145] Gyula O.H. Katona. Excluded subposets in the boolean lattice. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 229–230. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0145.abs.html

We are looking for the maximum number of subsets of an n-element set not containing 4 distinct subsets satisfying $A \subset B, C \subset B, C \subset D$. It is proved that this number is at least the number of the $\lfloor n \,/\, 2 \rfloor$-element sets times $1 + 2 \,/\, n$, on the other hand an upper bound is given with 4 replaced by the value 2.

[DMTCS-AE0146] Miri Priesler and Michael Tarsi. Multigraph decomposition into multigraphs with two underlying edges. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 231–234. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0146.abs.html

Due to some intractability considerations, reasonable formulation of necessary and sufficient conditions for decomposability of a general multigraph G into a fixed connected multigraph H, is probably not feasible if the underlying simple graph of H has three or more edges. We study the case where H consists of two underlying edges. We present necessary and sufficient conditions for H-decomposability of G, which hold when certain size parameters of G lies within some bounds which depends on the multiplicities of the two edges of H. We also show this result to be "tight" in the sense that even a slight deviation of these size parameters from the given bounds results intractability of the corresponding decision problem.

[DMTCS-AE0147] Frank Göring. Mader tools. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 235–238. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0147.abs.html

The deep theorem of Mader concerning the number of internally disjoint H-paths is a very powerfull tool. Nevertheless its use is very difficult, because one has to deal with a very reach family of separators. This paper shows several ways to strengthen Mader's theorem by certain additional restrictions of the appearing separators.

[DMTCS-AE0148] Zoran Nikoloski Narsingh Deo, and Ludek Kucera. Degree-correlation of scale-free graphs. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 239–244. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0148.abs.html

Barabási and Albert [1] suggested modeling scale-free networks by the following random graph process: one node is added at a time and is connected to an earlier node chosen with probability proportional to its degree. A recent empirical study of Newman [5] demonstrates existence of degree-correlation between degrees of adjacent nodes in real-world networks. Here we define the *degree correlation*—correlation of the degrees in a pair of adjacent nodes—for a random graph process. We determine asymptotically the joint probability distribution for node-degrees, d and d', of adjacent nodes for every $0 \leq d \leq d' \leq n^{1/5}$, and use this result to show that the model of Barabási and Albert does not generate degree-correlation. Our theorem confirms the result in [KR01], obtained by using the mean-field heuristic approach.

[DMTCS-AE0149] Jaroslav Nešetřil and Yared Nigussie. Density of universal classes of series-parallel graphs. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 245–250. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0149.abs.html

A class of graphs $\mathcal{C}$ ordered by the homomorphism relation is *universal* if every countable partial order can be embedded in $\mathcal{C}$. It was shown in [ZH] that the class $\mathcal{C}_k$ of k-colorable graphs, for any fixed $k \geq 3$, induces a universal partial order. In [HN1], a surprisingly small subclass of $\mathcal{C}_3$ which is a proper subclass of K_4-minor-free graphs ($\mathcal{G}/K_4$) is shown to be universal. In another direction, a density result was given in [PZ], that for each rational number $a/b \in [2, 8/3] \cup \{3\}$, there is a K_4-minor-free graph with circular chromatic number equal to a/b. In this note we show for each rational number a/b within this interval the class $\mathcal{K}_{a/b}$ of K_4-minor-free graphs with circular chromatic number a/b is universal if and only if $a/b \neq 2$, $5/2$ or 3. This shows yet another surprising richness of the K_4-minor-free class that it contains universal classes as dense as the rational numbers.

[DMTCS-AE0150] Gordana Manić and Yoshiko Wakabayashi. Packing triangles in low degree graphs and indifference graphs. In Stefan Felsner, editor, *2005 European Conference on*

Combinatorics, Graph Theory and Applications (EuroComb '05), volume AE of *DMTCS Proceedings*, pages 251–256. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0150.abs.html

We consider the problems of finding the maximum number of vertex-disjoint triangles (VTP) and edge-disjoint triangles (ETP) in a simple graph. Both problems are NP-hard. The algorithm with the best approximation guarantee known so far for these problems has ratio $3/2 + \varepsilon$, a result that follows from a more general algorithm for set packing obtained by Hurkens and Schrijver in 1989. We present improvements on the approximation ratio for restricted cases of VTP and ETP that are known to be APX-hard: we give an approximation algorithm for VTP on graphs with maximum degree 4 with ratio slightly less than 1.2, and for ETP on graphs with maximum degree 5 with ratio $4/3$. We also present an exact linear-time algorithm for VTP on the class of indifference graphs.

[DMTCS-AE0151] Hortensia Galeana-Sánchez and Mucuy-Kak Guevara. Semikernels modulo f in digraphs. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 257–262. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0151.abs.html

A kernel N of a digraph D is an independent set of vertices of D such that for every $w \in V(D) - N$ there exists an arc from w to N. If every induced subdigraph of D has a kernel, D is said to be a kernel perfect digraph. Minimal non-kernel perfect digraph are called critical kernel imperfect digraph. If F is a set of arcs of D, a semikernel modulo F, S of D is an independent set of vertices of D such that for every $z \in V(D) - S$ for which there exists an $Sz-$arc of $D - F$, there also exists an $zS-$arc in D. In this talk some structural results concerning critical kernel imperfect and sufficient conditions for a digraph to be a critical kernel imperfect digraph are presented.

[DMTCS-AE0152] Ross M. Richardson, Van H. Vu, and Lei Wu. Random inscribing polytopes. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 263–266. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0152.abs.html

For convex bodies K with $\mathcal{C}^2$ boundary in $\mathbb{R}^d$, we provide results on the volume of random polytopes with vertices chosen along the boundary of K which we call *random inscribing polytopes*. In particular, we prove results concerning the variance and higher moments of the volume, as well as show that the random inscribing polytopes generated by the Poisson process satisfy central limit theorem.

[DMTCS-AE0153] Dmitri G. Fon-Der-Flaass and Anna E. Frid. On infinite permutations. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 267–272. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0153.abs.html

We define an infinite permutation as a sequence of reals taken up to the order, or, equivalently, as a linear ordering of a finite or countable set. Then we introduce and characterize periodic permutations; surprisingly, for each period t there is an infinite number of distinct t-periodic permutations. At last, we introduce a complexity notion for permutations analogous to subword complexity for words, and consider the problem of minimal complexity of non-periodic permutations. Its answer is different for the right infinite and the bi-infinite case.

[DMTCS-AE0154] Daniela Kühn and Deryk Osthus. Matchings and hamilton cycles in hypergraphs. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 273–278. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0154.abs.html

It is well known that every bipartite graph with vertex classes of size n whose minimum degree is at least $n/2$ contains a perfect matching. We prove an analogue of this result for uniform hypergraphs. We also provide an analogue of Dirac's theorem on Hamilton cycles for 3-uniform hypergraphs: We say that a 3-uniform hypergraph has a Hamilton cycle if there is a cyclic ordering of its vertices such that every pair of consecutive vertices lies in a hyperedge which consists of three consecutive vertices. We prove that for every $\epsilon > 0$ there is an n_0 such that every 3-uniform hypergraph of order $n \geq n_0$ whose minimum degree is at least $n/4 + \epsilon n$ contains a Hamilton cycle. Our bounds on the minimum degree are essentially best possible.

[DMTCS-AE0155] Rajneesh Hegde and Kamal Jain. A min-max theorem about the road coloring conjecture. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 279–284. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0155.abs.html

The Road Coloring Conjecture is an old and classical conjecture posed in [adler70,adler77]. Let G be a strongly connected digraph with uniform out-degree 2. The Road Coloring Conjecture states that, under a natural (necessary) condition that G is "aperiodic", the edges of G can be colored red and blue such that "universal driving directions" can be given for each vertex. More precisely, each vertex has one red and one blue edge leaving it, and for any vertex v there exists a sequence s_v of reds and blues such that following the sequence from *any* starting vertex in G ends precisely at the vertex v. We first generalize the conjecture to a min-max conjecture for all strongly connected digraphs. We then generalize the notion of coloring itself. Instead of assigning exactly one color to each edge we allow multiple colors to each edge. Under this relaxed notion of coloring we prove our generalized Min-Max theorem. Using the Prime Number Theorem (PNT) we further show that the number of colors needed for each edge is bounded above by $O(\log n / \log \log n)$, where n is the number of vertices in the digraph.

[DMTCS-AE0156] Van H. Vu and Lei Wu. Improving the gilbert-varshamov bound for q-ary codes. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 285–288. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0156.abs.html

Given positive integers q, n and d, denote by $A_q(n,d)$ the maximum size of a q-ary code of length n and minimum distance d. The famous Gilbert-Varshamov bound asserts that $A_q(n,d+1) \geq q^n / V_q(n,d)$, where $V_q(n,d) = \sum_{i=0}^{d} \binom{n}{i}(q-1)^i$ is the volume of a q-ary sphere of radius d. Extending a recent work of Jiang and Vardy on binary codes, we show that for any positive constant α less than $(q-1)/q$ there is a positive constant c such that for $d \leq \alpha n$, $A_q(n,d+1) \geq cq^n \,/\, V_q(n,d)n$. This confirms a conjecture by Jiang and Vardy.

[DMTCS-AE0157] Tomoki Nakamigawa. Equivalent subgraphs of order 3. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 289–292. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0157.abs.html

It is proved that any graph of order $14n/3 + O(1)$ contains a family of n induced subgraphs of order 3 such that they are vertex-disjoint and equivalent to each other.

[DMTCS-AE0158] Gyula O.H. Katona and Krisztián Tichler. An extremal problem on trees and database theory. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 293–298. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0158.abs.html

We consider an extremal problem on labelled directed trees and applications to database theory. Among others, we will show explicit keysystems on an underlying set of size n, that cannot be represented by a database of less than $2^{n(1-c\cdot \log\log n/\log n)}$ rows.

[DMTCS-AE0159] Miroslava Cimráková and Veerle Fack. On minimal blocking sets of the generalized quadrangle. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 299–302. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0159.abs.html

The generalized quadrangle $Q(4,q)$ arising from the parabolic quadric in $PG(4,q)$ always has an ovoid. It is not known whether a minimal blocking set of size smaller than q^2+q (which is not an ovoid) exists in $Q(4,q)$, q odd. We present results on smallest blocking sets in $Q(4,q)$, q odd, obtained by a computer search. For $q = 5, 7, 9, 11$ we found minimal blocking sets of size q^2+q-2 and we discuss their structure. By an exhaustive search we excluded the existence of a minimal blocking set of size q^2+3 in $Q(4,7)$.

[DMTCS-AE0160] Tomáš Kaiser and Riste Škrekovski. Cycles intersecting edge-cuts of prescribed sizes. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph*

Theory and Applications (EuroComb '05), volume AE of *DMTCS Proceedings*, pages 303–308. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0160.abs.html

We prove that every cubic bridgeless graph G contains a 2-factor which intersects all (minimal) edge-cuts of size 3 or 4. This generalizes an earlier result of the authors, namely that such a 2-factor exists provided that G is planar. As a further extension, we show that every graph contains a cycle (a union of edge-disjoint circuits) that intersects all edge-cuts of size 3 or 4. Motivated by this result, we introduce the concept of a coverable set of integers and discuss a number of questions, some of which are related to classical problems of graph theory such as Tutte's 4-flow conjecture or the Dominating circuit conjecture.

[DMTCS-AE0161] Stefanie Gerke, Martin Marciniszyn, and Angelika Steger. A probabilistic counting lemma for complete graphs. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 309–316. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0161.abs.html

We prove the existence of many complete graphs in almost all sufficiently dense partitions obtained by an application of Szemerédi's Regularity Lemma. More precisely, we consider the number of complete graphs K_ℓ on ℓ vertices in ℓ-partite graphs where each partition class consists of n vertices and there is an ϵ-regular graph on m edges between any two partition classes. We show that for all $\beta > 0$, at most a β^m-fraction of graphs in this family contain less than the expected number of copies of K_ℓ provided ϵ is sufficiently small and $m \geq Cn^{2-1/(\ell-1)}$ for a constant $C > 0$ and n sufficiently large. This result is a counting version of a restricted version of a conjecture by Kohayakawa, Łuczak and Rödl [MR1479298] and has several implications for random graphs.

[DMTCS-AE0162] Francesc Aguiló and Alícia Miralles. Frobenius' problem. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 317–322. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0162.abs.html

Given k natural numbers $\{a_1, ..., a_k\} \subset \mathbb{N}$ with $1 \leq a_1 < a_2 < .. < a_k$ and $\gcd(a_1, ..., a_k) = 1$, let be $R(a_1, ..., a_k) = \{\lambda_1 a_1 + \cdots + \lambda_k a_k | \lambda_i \in \mathbb{N}, i = 1k\}$ and $\overline{R}(a_1, ..., a_k) = \mathbb{N}R(a_1, ..., a_k)$. It is easy to see that $|\overline{R}(a_1, ..., a_k)| < \infty$. The *Frobenius Problem* related to the set $\{a_1, ..., a_k\}$ consists on the computation of $f(a_1, ..., a_k) = \max \overline{R}(a_1, ..., a_k)$, also called the *Frobenius number*, and the cardinal $|\overline{R}(a_1, ..., a_k)|$. The solution of the Frobenius Problem is the explicit computation of the set $\overline{R}(a_1, ..., a_k)$. In some cases it is known a sharp upper bound for the Frobenius number. When $k = 3$ this bound is known to be

$$F(N) = \max_{0<a<b<N, gcd(a,b,N)=1} f(a, b, N) = \begin{cases} 2(\lfloor N/2 \rfloor - 1)^2 - 1 & \text{if } N \equiv 0 \pmod 2, \\ 2\lfloor N/2 \rfloor (\lfloor N/2 \rfloor - 1) - 1 & \text{if } N \equiv 1 \pmod 2. \end{cases}$$

This bound is given in [Dixmier1990]. In this work we give a geometrical proof of this bound which allows us to give the solution of the Frobenius problem for all the sets $\{\alpha, \beta, N\}$ such that $f(\alpha, \beta, N) = F(N)$.

[DMTCS-AE0163] Benjamin Doerr, Michael Gnewuch, and Nils Hebbinghaus. Discrepancy of products of hypergraphs. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 323–328. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0163.abs.html

For a hypergraph $\mathcal{H} = (V, \mathcal{E})$, its d–fold symmetric product is $\Delta^d\mathcal{H} = (V^d, \{E^d | E \in \mathcal{E}\})$. We give several upper and lower bounds for the c-color discrepancy of such products. In particular, we show that the bound $\text{disc}(\Delta^d\mathcal{H}, 2) \leq \text{disc}(\mathcal{H}, 2)$ proven for all d in [B. Doerr, A. Srivastav, and P. Wehr, Discrepancy of Cartesian products of arithmetic progressions, Electron. J. Combin. 11(2004), Research Paper 5, 16 pp.] cannot be extended to more than $c = 2$ colors. In fact, for any c and d such that c does not divide $d!$, there are hypergraphs having arbitrary large discrepancy and $\text{disc}(\Delta^d\mathcal{H}, c) = \Omega_d(\text{disc}(\mathcal{H}, c)^d)$. Apart from constant factors (depending on c and d), in these cases the symmetric product behaves no better than the general direct product $\mathcal{H}^d$, which satisfies $\text{disc}(\mathcal{H}^d, c) = O_{c,d}(\text{disc}(\mathcal{H}, c)^d)$.

[DMTCS-AE0164] Martin Marciniszyn, Dieter Mitsche, and Miloš Stojaković. Balanced avoidance games on random graphs. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 329–334. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0164.abs.html

We introduce and study balanced online graph avoidance games on the random graph process. The game is played by a player we call Painter. Edges of the complete graph with n vertices are revealed two at a time in a random order. In each move, Painter immediately and irrevocably decides on a balanced coloring of the new edge pair: either the first edge is colored red and the second one blue or vice versa. His goal is to avoid a monochromatic copy of a given fixed graph H in both colors for as long as possible. The game ends as soon as the first monochromatic copy of H has appeared. We show that the duration of the game is determined by a threshold function $m_H = m_H(n)$. More precisely, Painter will asymptotically almost surely (a.a.s.) lose the game after $m = \omega(m_H)$ edge pairs in the process. On the other hand, there is an essentially optimal strategy, that is, if the game lasts for $m = o(m_H)$ moves, then Painter will a.a.s. successfully avoid monochromatic copies of H using this strategy. Our attempt is to determine the threshold function for certain graph-theoretic structures, e.g., cycles.

[DMTCS-AE0165] Vladimir Blinovsky. Sets of integers without $k + 1$ coprimes and with specified divisors. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 335–340. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0165.abs.html

We find the formula for the cardinality of maximal set of integers from $[1, \ldots, n]$ which does not contain $k + 1$ pairwise coprimes and has divisors from a specified set of primes. This formula is defined by the set of multiples of the generating set, which does not depend on n.

[DMTCS-AE0166] Robert Berke and Tibor Szabó. Relaxed two-coloring of cubic graphs. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 341–344. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0166.abs.html

We show that any graph of maximum degree at most 3 has a two-coloring, such that one color-class is an independent set while the other color induces monochromatic components of order at most 189. On the other hand for any constant C we exhibit a 4-regular graph, such that the deletion of any independent set leaves at least one component of order greater than C. Similar results are obtained for coloring graphs of given maximum degree with $k + \ell$ colors such that k parts form an independent set and ℓ parts span components of order bounded by a constant. A lot of interesting questions remain open.

[DMTCS-AE0167] Gyula Y. Katona. Hamiltonian chains in hypergraphs. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 345–350. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0167.abs.html

Hamiltionian chain is a generalisation of hamiltonian cycles for hypergraphs. Among the several possible ways of generalisations this is probably the most strong one, it requires the strongest structure. Since there are many interesting questions about hamiltonian cycles in graphs, we can try to answer these questions for hypergraphs, too. In the present article we give a survey on results about such questions.

[DMTCS-AE0168] Jun Tarui. On the minimum number of completely 3-scrambling permutations. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 351–356. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0168.abs.html

A family $\mathcal{P} = \{\pi_1, \ldots, \pi_q\}$ of permutations of $[n] = \{1, \ldots, n\}$ is *completely k-scrambling* [Spencer, 1972; Füredi, 1996] if for any distinct k points $x_1, \ldots, x_k \in [n]$, permutations π_i's in $\mathcal{P}$ produce all $k!$ possible orders on $\pi_i(x_1), \ldots, \pi_i(x_k)$. Let $N^*(n, k)$ be the minimum size of such a family. This paper focuses on the case $k = 3$. By a simple explicit construction, we show the following upper bound, which we express together with the lower bound due to Füredi for comparison.

$$2 \,/\, \log_2 e \log_2 n \leq N^*(n, 3) \leq 2 \log_2 n + (1 + o(1)) \log_2 \log_2 n.$$

We also prove the existence of $\lim_{n\to\infty} N^*(n, 3)/\log_2 n = c_3$. Determining the value c_3 and proving the existence of $\lim_{n\to\infty} N^*(n, k)/\log_2 n = c_k$ for $k \geq 4$ remain open.

[DMTCS-AE0169] Pascal Ochem. Negative results on acyclic improper colorings. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 357–362. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0169.abs.html

Raspaud and Sopena showed that the oriented chromatic number of a graph with acyclic chromatic number k is at most $k2^{k-1}$. We prove that this bound is tight for $k \geq 3$. We also show that some improper and/or acyclic colorings are NP-complete on a class $\mathcal{C}$ of planar graphs. We try to get the most restrictive conditions on the class $\mathcal{C}$, such as having large girth and small maximum degree. In particular, we obtain the NP-completeness of 3-ACYCLIC COLORABILITY on bipartite planar graphs with maximum degree 4, and of 4-ACYCLIC COLORABILITY on bipartite planar graphs with maximum degree 8.

[DMTCS-AE0170] Tomáš Dvořák, Petr Gregor, and Václav Koubek. Spanning paths in hypercubes. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 363–368. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0170.abs.html

Given a family $\{u_i, v_i\}_{i=1}^k$ of pairwise distinct vertices of the n-dimensional hypercube Q_n such that the distance of u_i and v_i is odd and $k \leq n-1$, there exists a family $\{P_i\}_{i=1}^k$ of paths such that u_i and v_i are the endvertices of P_i and $\{V(P_i)\}_{i=1}^k$ partitions $V(Q_n)$. This holds for any $n \geq 2$ with one exception in the case when $n = k+1 = 4$. On the other hand, for any $n \geq 3$ there exist n pairs of vertices satisfying the above condition for which such a family of spanning paths does not exist. We suggest further generalization of this result and explore a relationship to the problem of hamiltonicity of hypercubes with faulty vertices.

[DMTCS-AE0171] Gill Barequet, Micha Moffie, Ares Ribó, and Günter Rote. Counting polyominoes on twisted cylinders. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 369–374. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0171.abs.html

We improve the lower bounds on Klarner's constant, which describes the exponential growth rate of the number of polyominoes (connected subsets of grid squares) with a given number of squares. We achieve this by analyzing polyominoes on a different surface, a so-called *twisted cylinder* by the transfer matrix method. A bijective representation of the "states" of partial solutions is crucial for allowing a compact representation of the successive iteration vectors for the transfer matrix method.

[DMTCS-AE0172] Gábor Simonyi and Gábor Tardos. Local chromatic number and topology. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 375–378. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0172.abs.html

The local chromatic number of a graph, introduced by Erdős et al. in [EFHKRS], is the minimum number of colors that must appear in the closed neighborhood of some vertex in any proper coloring of the graph. This talk, based on the papers [ST1, ST2, ST3], would like to survey some of our recent results on this parameter. We give a lower bound for the local chromatic number in terms of the lower bound of the chromatic number provided by the topological method introduced by Lovász. We show that this bound is tight in many cases. In particular, we determine the local chromatic number of certain odd chromatic Schrijver graphs and generalized Mycielski graphs. We further elaborate on the case of 4-chromatic graphs and, in particular, on surface quadrangulations.

[DMTCS-AE0173] Hong-Jian Lai, Yehong Shao, Ju Zhou, and Hehui Wu. Every 3-connected, essentially 11-connected line graph is hamiltonian. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 379–382. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0173.abs.html

Thomassen conjectured that every 4-connected line graph is hamiltonian. A vertex cut X of G is essential if $G - X$ has at least two nontrivial components. We prove that every 3-connected, essentially 11-connected line graph is hamiltonian. Using Ryjáček's line graph closure, it follows that every 3-connected, essentially 11-connected claw-free graph is hamiltonian.

[DMTCS-AE0174] Manuel Bodirsky, Omer Giménez, Mihyun Kang, and Marc Noy. On the number of series parallel and outerplanar graphs. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 383–388. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0174.abs.html

We show that the number g_n of labelled series-parallel graphs on n vertices is asymptotically $g_n \sim g{\cdot}n^{-5/2}\gamma^n n!$, where γ and g are explicit computable constants. We show that the number of edges in random series-parallel graphs is asymptotically normal with linear mean and variance, and that the number of edges is sharply concentrated around its expected value. Similar results are proved for labelled outerplanar graphs.

[DMTCS-AE0175] Guillaume Fertin and André Raspaud. Acyclic coloring of graphs of maximum degree Δ. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 389–396. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0175.abs.html

An acyclic coloring of a graph G is a coloring of its vertices such that: (i) no two neighbors in G are assigned the same color and (ii) no bicolored cycle can exist in G. The acyclic chromatic number of G is the least number of colors necessary to acyclically color G, and is denoted by $a(G)$. We show that any graph of maximum degree Δ has acyclic chromatic number at most $\Delta(\Delta - 1) / 2$ for any $\Delta \geq 5$, and we give an $O(n\Delta^2)$ algorithm to acyclically color any graph of maximum degree Δ with the above mentioned number of colors. This result is roughly two times better than the best general upper bound known so far, yielding $a(G) \leq \Delta(\Delta - 1) + 2$ [albert]. By a deeper study of the case $\Delta = 5$, we also show that any graph of maximum degree 5 can be acyclically colored with at most 9 colors, and give a linear time algorithm to achieve this bound.

[DMTCS-AE0176] Vladimir K. Leontiev. Hamiltonian cycles in torical lattices. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 397–400. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0176.abs.html

We establish sufficient conditions for a toric lattice $T_{m,n}$ to be Hamiltonian. Also, we give some asymptotics for the number of Hamiltonian cycles in $T_{m,n}$.

[DMTCS-AE0177] Philippe Nadeau. Walks reaching a line. In Stefan Felsner, editor, *2005 European Conference on Combinatorics, Graph Theory and Applications (EuroComb '05)*, volume AE of *DMTCS Proceedings*, pages 401–406. Discrete Mathematics and Theoretical Computer Science, 2005.

http://www.dmtcs.org/proceedings/html/dmAE0177.abs.html

We enumerate walks in the plane $\mathbb{R}^2$, with steps East and North, that stop as soon as they reach a given line; these walks are counted according to the distance of the line to the origin, and we study the asymptotic behavior when the line has a fixed slope and moves away from the origin. When the line has a rational slope, we study a more general class of walks, and give exact as well as asymptotic enumerative results; for this, we define a nice bijection from our walks to words of a rational language. For a general slope, asymptotic results are obtained; in this case, the method employed leads us to find asymptotic results for a wider class of walks in $\mathbb{R}^m$.