ARTICLE IN PRESS

European Journal of Combinatorics ▮ (▮▮▮▮) ▮▮▮–▮▮▮

Contents lists available at ScienceDirect

European Journal of Combinatorics

journal homepage: www.elsevier.com/locate/ejc

Preface

We are pleased to dedicate this special issue of the European Journal of Combinatorics to Michel Deza on the occasion of his 70th birthday, celebrated on April 27, 2009. This issue includes research articles by a selected group of authors – some of his students, colleagues, collaborators and friends.

M. Deza is a distinguished figure in contemporary discrete mathematics. He graduated in 1961 from Moscow University where he learned to love mathematics by following lectures from professors such as P.S. Alexandrov, B.N. Delone, A.A. Markov and A.N. Kolmogorov. Then he took a position as researcher in the Academy of Sciences of USSR until his emigration in 1972 to France. From 1973 until his retirement in 2005, he served as a researcher at CNRS (Centre National de la Recheche Scientifique) in Paris.

Michel Deza's most important research contributions are in discrete, combinatorial and applied geometry, but his mathematical interests are much more broader and include areas where discrete geometry meets algebra, classical combinatorics, graph theory, number theory, optimization, analysis and applications. Many of his works have had impacts in other various scientific domains, especially organic chemistry (on fullerenes and symmetry) and crystallography (Frank–Kasper phases, alloys, and viruses). M. Deza has a strong impact on the development of all of these domains for well over forty years. From very early on, he was distinguished for his combinatorial geometry intuition and problem solving skills. As an example, one of his favorite research domains is the finite metric spaces. In 1959, he had already discovered that l_1-space has the hypermetric property. Later, in a joint work, he proved that a finite rationally valued metric embeds isometrically into an l_1-space if and only if it embeds, up to a scale, in a hypercube. The interpretation of hypermetrics in terms of (Delone polytopes of) point lattices followed. Now many people work on this, especially on metric embedding with a distortion. In 1973, he met Erdös and solved one of his highly prized problems on weak/strong delta systems—namely that members of any sufficiently large family of k-subsets (of an n-set) with equal size t of intersection (i.e. a weak delta system) all intersect in a t-set, i.e. form a strong delta system [*Solution d'un problème de Erdös and_Lovász*, JCT B-16, 1974]. Moreover, the moment of transition gave a new characterization of finite projective planes. Michel Deza is still sorry that he did not keep the Erdös check as a framed picture! After, he co-authored four papers with P. Erdös on various subjects of number theory and combinatorics. But especially, he decided to imitate the Erdös lifestyle: mathematics and travel.

M. Deza is a member of European Academy of Sciences; from 2007 he has been its vice-president. He is on the editorial board of a dozen mathematical journals. From 1980 until 2008 he was co-editor in chief of the European Journal of Combinatorics. He is also co-author of five very popular scientific books. Many follow-ups of his results on metric spaces appear in the books *Geometry of Cuts and Metrics* (Springer, 1997) and *Scale-Isometric Polytopal Graphs in Hypercubes and Cubic Lattices* (Imperial College Press and World Scientific, 2004). He is also co-author of *The Dictionary of Distances* (Elsevier, 2006), *Geometry of Chemical Graphs* (Cambridge University Press, 2008) and *The Encyclopedia of Distances* (Springer, in print). The first three of these books are translated into Russian. The list of

0195-6698/$ – see front matter
doi:10.1016/j.ejc.2009.03.020

Please cite this article in press as: Y. Manoussakis, Preface, European Journal of Combinatorics (2009), doi:10.1016/j.ejc.2009.03.020

his co-authors (or co-editors of books) contains 75 persons. He co-organized a dozen mathematical international conferences, while he published more than two hundred and fifty papers in high level scientific journals and proceedings.

Let us say now a few words about the content of the present issue. First of all we are very grateful to all the contributors and referees. We are also particularly grateful to Pierre Rosensthiel, who, as one of the editors in chief of the European Journal of Combinatorics, kindly accepted allowing the publication of this issue. This collection of papers includes sixteen contributions by people working on subjects influenced by M. Deza. It varies among such fields as:

-finite geometry,
-design theory,
-graph theory,
-classical combinatorics,
-codes and packings.

Most of these results were exposed for the first time at the conference on *Combinatorics, Geometry and Computer Science*, held at CIRM, Luminy, France, 2–4 May 2007. At the end of the issue there are added a collection of problems kindly prepared by P.J. Cameron as well as the talk by M. Deza, both presented at the above mentioned conference.

In what follows, we give a brief description of the papers published in this issue.

Finite geometry

The paper by K. Fukuda and C. Weibel centers on Minkowski sums of polytopes in relatively general position and properties of these sums. Among other results, they show that the maximum number of faces in the sum may be attained by this family. They also present a linear equation satisfied by f-vectors of the sum and the summands. The interest of these results is that they may be used to establish general statements about Minkowski sums.

B. Jackson and T. Jordan consider relations between multigraphs and sets of d-dimensional rigid bodies in the d-dimensional Euclidean space connected by bars and hinges. They characterize multigraphs which can be realized by such infinitesimally rigid frameworks. They also obtain a sufficient condition for multigraphs realized by frameworks with the additional constraint that all hinges of the framework lie in the same hyperplane. The interest of these results is that they are related to a long-standing conjecture of Tay and Whiteley, which, if true, would characterize when a multigraph may be realized by rigid frameworks in which all the hinges incident to each body lie in a common hyperplane.

H. Maehara's paper deals with a variation of the famous Steinhaus problem, namely, whether there is a circle in the plane that encloses a given number of lattice points. Here the author shows that there exists a sphere in R^d that passes through precisely n lattice points and the n lattice points span an m-dimensional flat, $n > d >= m >= 2$. As a consequence, it is shown that for every positive integer d, there is a d-simplex in R^d whose vertices are all lattices points, and whose circumscribe sphere passes through no lattice points other than the vertices of the simplex.

Design theory

The paper by Ei. Bannai and Et. Bannai has several purposes. The main purpose is to study (tight) Euclidean t-designs, a concept which is a two-step generalization of spherical t-designs, that is, a finite subset of the unique sphere which approximates the sphere well with respect to the integrals of polynomials. The generalization of one step is to replace the sphere by Euclidean space while that of the second step is to consider weighted designs or equivalently cubature formulas. Thus a second purpose of the paper is to inform on the important role of cubature formulas in combinatorial analysis and the role of t-designs to algebraic combinatorics.

R. Euler deals with incomplete Latin squares. Recall that in a Latin square each symbol occurs in each row and in each column exactly once. A Latin square is incomplete whenever some symbols are missing. One, still open, fundamental problem consists of characterizing those incomplete Latin squares which are completable to a Latin square of the same order. Here the author introduces the concept of the availability matrix and then applies a theorem of Frobenius and Köning in order to obtain a nice characterization for the completability of an incomplete Latin square.

N. Singhi establishes a structure theory for semiadditive rings and shows relationships of semiadditive rings with the projective planes. These new methods are being developed with the aim

Please cite this article in press as: Y. Manoussakis, Preface, European Journal of Combinatorics (2009), doi:10.1016/j.ejc.2009.03.020

of studying the well-known conjecture that every finite projective plane with no proper subplane is isomorphic to a prime field plane and that the order of a finite projective plane is a power of a prime number.

Graph theory

J.M. Becu et al. deal with the colored version of the k-linked (k-edge-linked) property in edge-colored graphs. A subgraph of an edge-colored graph is said to be properly edge-colored if any two adjacent edges in this subgraph differ in color. A graph is k-linked (k-edge-linked) whenever for every k pairs of vertices $x_1-y_1, x_2-y_2, \ldots x_k-y_k$, there exist k vertex-disjoint (edge-disjoint) properly edge-colored paths in the graph, one per pair x_i-y_i, for each $i = 1, 2, \ldots, k$. Here they establish conditions on colored degrees and/or number of arcs, sufficient for the k-linked (k-edge-linked) property in edge-colored graphs.

Y. Boudabous and M. Pouzet study decompositions of graphs into simpler subgraphs. Here they are interested in acyclically indecomposable tournaments, that is, tournaments where no acyclic autonomous set of vertices has more than one element. They identify twelve infinite acyclically indecomposable tournaments and prove that every infinite acyclically indecomposable tournament contains a subtournament isomorphic to one of these twelve tournaments.

A. Kramer and N. Zgaglia-Salvi consider an isomorphism σ between directed De Bruijn graphs $B(2, n)$ of diameter 2, degree n and their converses. The converse of a digraph is defined to be the one obtained by reversing the direction of the arcs of the initial one. A directed cycle C is said to be σ-self-converse if the cycle $\sigma(C)$ coincides with its converse. In this work, they determine characterizations of σ-self-converse cycles on various values of n.

H.H. Lai and K.W. Lih study full orientability of graphs. An orientation assigns a direction to each edge of the graph. It is acyclic if the directed graph obtained is acyclic. An arc is dependent if the reversal of its direction creates a cycle in the directed graph. A graph is defined to be fully orientable if it admits an acyclic orientation with exactly k dependent arcs for every k varying between the minimum and the maximum degree of the graph. Here the authors study conditions under which full orientability of a graph can be preserved when the graph is extended by attaching new paths or cycles. Also full orientability of various families of graphs is established.

H. Li, S. Zhou and G. Wang deal with the concept of k-dominating cycles in simple graphs, i.e., longest cycles such that no component of the graph outside the cycle has more than k vertices. For instance a Hamiltonian cycle is a 0-dominating one. In this paper they give degree conditions sufficient for the existence of k-dominating cycles in $(k+2)$-connected graphs.

Classical combinatorics

V. Chepoi et al. investigate a constraint satisfaction problem which extends the well-known SAT problem (satisfiability of Boolean formulas in conjunctive normal form) and has a strong combinatorial flavor. In particular here the structure is expressed by membership constraints. Clauses are disjunctions of atomic propositions of x belonging to S, where x is a variable and S is a finite set from a given family of sets defined on a specified domain. Here they show that checking the satisfiability of such formulas with three or more literals is NP-complete except for the trivial case when the intersection of all sets S is non-empty.

I. Fanti et al. present a recursive generating algorithm for unrestricted permutations. Their technique is based on the decomposition of a permutation as a product of transpositions and that as a union of disjoint cycles. Slightly different versions of this algorithm may be used in various situations, as Bell permutations and involutions, permutations counted with the Stirling number, even permutations, pure involutions and derangements.

Codes and packings

P.J. Cameron's paper is a nice survey of old and new results concerning sets and groups of permutations, concentrating on the analogies and on the relations to coding theory. Some open problems are discussed.

I. Charon et al. investigate codes in the binary Hamming space F^n of dimension n, also called the binary n-cube. A subset of F^n is said to be an r-identifying code if its intersection with the ball of radius r and center x is non-empty and distinct, where r is a non-zero positive integer and x is an element of F^n. Here the authors give new constructive upper bounds for the minimum cardinalities of r-identifying codes in the Hamming space.

Please cite this article in press as: Y. Manoussakis, Preface, European Journal of Combinatorics (2009), doi:10.1016/j.ejc.2009.03.020

M. Dutour-Sikiric and Y. Itoh consider sequential random packing of integral translates of cubes $[0, N]^n$ to $[0, 2N]^n$ and the torus, for large N. In the case of $[0, 2N]^n$, continuous packings are reduced to a single cube with high probability. In the torus case, some results are obtained depending upon the values of n. They also introduce the concept of continuous torus cube packing and prove several results concerning that. Related problems are proposed.

Yannis Manoussakis
Université Paris Sud, 11, LRI, Bât 490,
91405 Orsay Cedex, France
E-mail address: yannis@lri.fr.

Available online xxxx

Please cite this article in press as: Y. Manoussakis, Preface, European Journal of Combinatorics (2009), doi:10.1016/j.ejc.2009.03.020