Annotated List of Publications

Christopher R. H. Hanusa

Hanusa, Christopher R. H. Ensuring every candidate wins under positional voting. Submitted, 2007.

Given a fixed set of voter preferences, different candidates may win outright given different scoring rules. We investigate how many voters are able to allow all n candidates to win for some scoring rule. We will say that these voters impose a disordering on these candidates. The minimal number of voters it takes to impose a disordering on 3 candidates is 9. For 4 candidates, 6 voters are necessary, for 5 candidates, 4 voters are necessary, and it takes only 3 voters to disorder 9 candidates. In general, we prove that m voters can disorder n candidates when m and n are both greater than or equal to 3, except when $m = 3$ and $n \leq 8$, when $n = 3$ and $m \leq 8$, and when $n = 4$ and m equals 4 or 5.

Chaiken, Seth, Christopher R. H. Hanusa, and Thomas Zaslavsky, Queens on a rectangular strip. Submitted, 2007.

The function that counts the number of ways to place nonattacking identical chess or fairy chess pieces in a rectangular strip of fixed height and variable width, as a function of the width, is a piecewise polynomial which is eventually a polynomial and whose behavior can be described in some detail. We deduce this by converting the problem to one of counting lattice points outside an affinographic hyperplane arrangement, which Forge and Zaslavsky solved by means of weighted integral gain graphs. We extend their work by developing both generating functions and a detailed analysis of deletion and contraction for weighted integral gain graphs. For chess pieces we find the asymptotic probability that a random configuration is nonattacking, and we obtain exact counts of nonattacking configurations of small numbers of queens, bishops, knights, and nightriders.

Hanusa, Christopher R. H. Applying a combinatorial determinant to count weighted cycle systems in a directed graph. Submitted, 2007.

One method for counting weighted cycle systems in a graph entails taking the determinant of the identity matrix minus the adjacency matrix of the graph. The result of this operation is the sum over cycle systems of -1 to the power of the number of disjoint cycles times the weight of the cycle system. The author uses this fact to reprove that the determinant of a matrix of much smaller order can be computed to calculate the number of cycle systems in a hamburger graph.

Hanusa, Christopher R. H. Pseudo-centrosymmetric matrices, with applications to counting perfect matchings. Linear Algebra Appl., Vol 427 (**2-3**), pp. 206–217, 2007.

We consider square matrices A that commute with a fixed square matrix K, both with entries in a field F not of characteristic 2. When $K^2 = I$, Tao and Yasuda defined A to be generalized centrosymmetric with respect to K. When $K^2 = -I$, we define A to be pseudo-centrosymmetric with respect to K; we show that the determinant of every even-order pseudo-centrosymmetric matrix is the sum of two squares over F, as long as -1 is not a square in F. When a pseudo-centrosymmetric matrix A contains only integral entries and is pseudo-centrosymmetric with respect to a matrix with rational entries, the determinant of A is the sum of two integral squares. This result, when specialized to when K is the even-order alternating exchange matrix, applies to enumerative combinatorics. Using solely matrix-based methods, we reprove a weak form of Jockusch's theorem for enumerating perfect matchings of 2-even symmetric graphs. As a corollary, we reprove that the number of domino tilings of regions known as Aztec diamonds and Aztec pillows is a sum of two integral squares.

Hanusa, Christopher R. H. A Gessel–Viennot-type method for cycle systems in a directed graph. Electron. J. Combin., 13 (2006), Research Paper 37, 28 pp. (electronic).

We introduce a new determinantal method to count cycle systems in a directed graph that generalizes Gessel and Viennot's determinantal method on path systems. The method gives new insight into the enumeration of domino tilings of Aztec diamonds, Aztec pillows, and related regions.

Benjamin, A. T., Christopher R. H. Hanusa, and Francis E. Su. Linear Recurrences Through Tilings and Markov Chains. Utilitas Mathematica, Vol 64, pp. 3–17, November 2003.

We present a tiling interpretation for k^{th} order linear recurrences, which yields new combinatorial proofs for recurrence identities. Moreover, viewing the tiling process as a Markov chain also yields closed form Binet-like expressions for these recurrences.

Hanusa, Christopher R. H., Ari Nieh, and Matthew Schnaider. Jammin' with Floyd: A Traffic Flow Analysis of South Carolina Hurricane Evacuation. UMAP Journal Vol 22 (**3**) 2001.

We analyze the 1999 Hurricane Floyd evacuation with a traffic-flow model, explaining the extreme congestion on I-26.

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