KIAS Workshop on Combinatorics

Korea Institute for Advanced Study, Seoul, Korea
May 30 - June 1, 2013

Information

Title: KIAS Workshop on Combinatorics

Date: May 30 - June 1 (Thu-Sat), 2013

Venue: Room 1503, KIAS

Web: http://kias.combinatorics.kr

Invited Speakers

Gi-Sang Cheon, Sungkyunkwan University

Jeong Ok Choi, GIST

Mitsugu Hirasaka, Pusan National University

Hyun Kwang Kim, POSTECH

Sangwook Kim, Chonnam National University

Seog-Jin Kim, Konkuk University

Younjin Kim, KAIST

Youngsoo Kwon, Yeungnam University

Seunghyun Seo, Kangwon National University

Hwanchul Yoo, KIAS

Timetable

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Break</td></tr>
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Speaker Gi-Sang Cheon, Sungkyunkwan University

Title The Riordan group and related topics in Combinatorics and Matrix Theory

Abstract The Riordan group is the set of infinite lower triangular matrices whose kth column has the generating function $g(z)f(z)^k$ where g and f are elements of the ring of formal power series $\mathbb{C}[[z]]$ such that $g(0) = 1$, $f(0) = 0$ and $f'(0) \neq 0$. Such a matrix is called Riordan matrix and denoted as $(g(z), f(z))$ or (g, f). The Riordan group shows up naturally in a variety of combinatorial settings and combinatorial matrix theory. This talk is given by two parts. The concept of Riordan group and Riordan matrix will be introduced in the first part by presenting fundamental properties and interesting subgroups. In the second part, we discuss how this concept can be applied to several problems arising in combinatorics and matrix theory.

Speaker Seog-Jin Kim, Konkuk University

Title Coloring of the square of Kneser graphs

Abstract The Kneser graph $K(n, k)$ is the graph whose vertices are the k-elements subsets of an n-element set, with two vertices adjacent if the sets are disjoint. The square G^2 of a graph G is the graph defined on $V(G)$ such that two vertices u and v are adjacent in G^2 if the distance between u and v in G is at most 2. We denote the square of the Kneser graph $K(n, k)$ by $K^2(n, k)$. The problem of computing $\chi(K^2(n, k))$, which was originally posed by Füredi, was introduced and discussed by Kim and Nakprasit (2004).

Note that that A and B are adjacent in $K^2(n, k)$ if and only if $A \cap B = \emptyset$ or $|A \cap B| \geq 3k - n$. Therefore, $K^2(n, k)$ is the complete graph K_t where $t = \binom{n}{k}$ if $n \geq 3k - 1$, and $K^2(n, k)$ is a perfect matching if $n = 2k$. But for $2k + 1 \leq n \leq 3k - 2$, the exact value of $\chi(K^2(n, k))$ is not known. Hence it is an interesting problem to determine the chromatic number of the square of the Kneser graph $K(2k + 1, k)$ as the first nontrivial case. We will give a brief introduction of the problem, and present recent results. This talk is based on joint work with Boram Park.

Speaker Hyun Kwang Kim, POSTECH

Title Polytope numbers and their applications

Abstract These is an introductory lecture on combinatorial properties of polytope numbers. We first introduce polytope numbers and their basic properties such as product formula and decomposition theorems. Next we illustrate these properties with some well-known polytopes. Finally we give research problems related to polytope numbers.

Speaker Jeong Ok Choi, GIST

Title Fractional weak discrepancy of posets

Abstract In this talk, various discrepancies of posets (Partially Ordered Sets) will be introduced. In particular, fractional weak discrepancy of a poset is emphasized as a refinement of measuring weakness of a poset. We characterize forbidden structure for posets preventing fractional weak discrepancy larger than k for each natural number k. Also, we give the range of fractional weak discrepancy of $(M, 2)$-free posets.

Speaker Mitsugu Hirasaka, Pusan National University

Title Zeta functions of adjacency algebras of association schemes

Abstract For a module L which has only finitely many submodules with a given finite index we define the zeta function of L to be a formal Dirichlet series $\zeta_L(s) = \sum_{n\geq 1} a_n n^{-s}$ where a_n is the number of submodules of L with index n. For a commutative ring R and an association scheme (X, S) we denote the adjacency algebra of (X, S) over R by RS. In this talk we aim to compute $\zeta_{\mathbb{Z}S}(s)$ under several assumptions where $\mathbb{Z}S$ is viewed as a regular $\mathbb{Z}S$-module.

Speaker Youngsoo Kwon, Yeungnam University

Title Classification of regular embeddings of some graph families

Abstract A regular embedding is a highly symmetric graph embedding onto a surface. Classifications of regular embeddings are pursued by three different directions: by given graphs, groups and surfaces. In this talk, we will consider classification of regular embeddings of graphs. I will introduce several methods to classify regular embeddings of graphs and some recent results.

Speaker Seunghyun Seo, Kangwon National University

Title Colored permutations and generalizations of derangements

Abstract A derangement is a permutation without any fixed points. There are several generalizations of derangements in the literature. In this talk, we introduce 5 types of colored permutations which are all generalizations of derangements. We present the generating function of each type and find the hierarchy of them combinatorially. We also present bijective proofs among the objects. This is joint work with Dongsu Kim(NIMS) and Jang Soo Kim(KIAS).

Speaker Hwanchul Yoo, KIAS

Title Balanced labellings of affine permutations and symmetric functions

Abstract In this talk, we introduce a generalization of the balanced labellings of Fomin, Greene, Reiner, and Shimozono. We extend the notion in two directions: (1) we define the diagrams of affine permutations and the balanced labellings on them; (2) we define the set-valued version of the balanced labellings. We show that the column-strict balanced labellings on the diagram of an affine permutation yield the affine Stanley symmetric function defined by Lam, and that the column-strict set-valued balanced labellings yield the affine stable Grothendieck polynomial of Lam. Moreover, once we impose suitable flag conditions, the flagged column-strict set-valued balanced labellings on the diagram of a finite permutation give a monomial expansion of the Grothendieck polynomial of Lascoux and Schützenberger. We also give a necessary and sufficient condition for a diagram to be an affine permutation diagram.

Speaker Sangwook Kim, Chonnam National University

Title Flag enumeration of matroid base polytopes

Abstract For a matroid on $[n]$, a matroid base polytope is the polytope in $\mathbb{R}^n$ whose vertices are the incidence vectors of the bases of the matroid. In this talk, we discuss flag information of matroid base polytopes for some classes of matroids such as rank 2 matroids and lattice path matroids

Speaker Younjin Kim, KAIST

Title On Combinatorial problems of Erdős

Abstract For a property Γ and a family of sets $\mathcal{F}$, let $f(\mathcal{F}, \Gamma)$ be the size of the largest subfamily of $\mathcal{F}$ having property Γ. For a positive integer m, let $f(m, \Gamma)$ be the minimum of $f(\mathcal{F}, \Gamma)$ over all families of size m. In 1972, Erdős and Shelah also considered Γ to be the property that no four distinct sets satisfy $F_1 \cup F_2 = F_3$ and $F_1 \cap F_2 = F_4$. Such families are called B_2-free. Erdős and Shelah gave an example showing $f(m, B_2\text{-free}) \leq (3/2)m^{2/3}$ and they also conjectured $f(m, B_2\text{-free}) > c_2 m^{2/3}$. We verify a conjecture of Erdős and Shelah from 1972.

In1964, Erdős, Hajnal, and Moon introduced the following problem : get the minimum size of a graph G such that G does not contain F as a subgraph but the addition of any new edge creates at least one copy of F in G. This minimum is called the *saturation number* of F. We obtain the saturation number of C_k, where C_k is a cycle with length k.