Japan-Korea Workshop on Algebra and Combinatorics[1]

Second Announcement

The 9th Japan-Korea Workshop on Algebra and Combinatorics will take place at Graduate School of Information Sciences, Tohoku University, Aoba-yama Campus, from 24–25 January 2011. The workshop is held once a year, alternately in Japan and in Korea. It is intended to provide researchers of both countries, especially young researchers including graduate students, with opportunities to exchange rather informal information of ongoing studies in the area. Further information is available from the organizers below.

Organizing Committee:
Eiichi Bannai (Kyushu University)
Jung Rae Cho (Pusan National University)
Mitsugu Hirasaka (Pusan National University)
Tatsuro Ito (Kanazawa University)
Hyun Kwang Kim (POSTECH)
Jack Koolen (POSTECH)
Akihiro Munemasa (Tohoku University)

Program

January 24–25, 2011
Main Lecture Hall, 2nd Floor,
Graduate School of Information Sciences,
Tohoku University, Aobayama Campus

January 24 (Monday)

9:35 − 09:40 Opening

9:40 − 10:25 Sonoko Moriyama (Tohoku University)
     Shellings and geometric realizability

10:40 − 11:25 Andreas Holmsen (KAIST)
     Partitions of point sets in Euclidean space and colorful theorems in convexity

11:40 − 12:25 Masanori Sawa (Nagoya University)
     An approach to the existence problem of minimal formula based on the Larman-Rogers-Seidel theorem

13:45 − 14:30 Suh-Ryung Kim (Seoul National University)
     On competition numbers of graphs

14:45 − 15:30 Boram Park (Seoul National University)
     On Opsut's conjecture for hypercompetition numbers of hypergraphs

15:50 − 16:35 Takao Komatsu (Hirosaki University)
     Characterization of linear recurrences associated to rays in Pascal's triangle and combinatorial identities

16:50 − 17:35 Manabu Oura (Kochi University)
     Some computations concerning to the average weight enumerators

18:00 − 20:00 Banquet

January 25 (Tuesday)

9:40 – 10:25 Nobuaki Obata (Tohoku University)
Quantum probabilistic approach to spectral analysis of networks: Some recent results

10:40 – 11:25 Yoshio Sano (POSTECH)
The non-bipartite integral graphs with spectral radius three

11:40 – 12:25 Kijung Kim (POSTECH)
Disconnecting strongly regular graphs

13:45 – 14:30 Tsuyoshi Miezaki (Tohoku University)
Conformal designs based on lattice vertex operator algebras

14:45 – 15:30 Heesung Shin (POSTECH)
Bijections between Entringer families

15:50 – 16:35 Mitsugu Hirasaka (Pusan National University)
Adjacency between two copies of association schemes of prime order

16:40 – 16:50 Closing

Accommodation

There are a number of reasonable hotels in the center of Sendai, where a direct bus service is available to Aobayama campus.

Satellite Mini-Workshop

We are planning a satellite seminar for young researchers on 26th of January at the same building as the workshop. See the homepage
`http://sites.google.com/site/tmiezaki/events/jk2011s`
for further information and contact the local organizer Dr. Miezaki
`miezaki@math.is.tohoku.ac.jp`
if you have any question.

Abstracts

Speaker: Sonoko Moriyama (Tohoku University)

Title: Shellings and geometric realizability

Abstract: A shelling structure of a polytopal complex C is a particular way of putting a total order on the facets of C. When C is realized as the boundary complex of a convex polytope P, there is a subclass of shellings, called line shellings, of the complex. Each line shelling induces an LP graph on the dual polytope P* of P. In this talk, using the relation between line shellings of the boundary complex of P and LP graphs on P*, we investigate polytopal digraphs and combinatorial structures of hyperplane arrangements which can or cannot be geometrically realized (for short, realizable or non-realizable).

Speaker: Andreas Holmsen (KAIST)

Title: Partitions of point sets in Euclidean space and colorful theorems in convexity

Abstract: Tverberg's theorem from 1966 states that any set of $(n+1)(k-1)+1$ points in R^n can be partitioned into k non-empty sets whose convex hulls have non-empty intersection. This classical result has many extensions, and in this talk I will present various results and conjectures concerning convexity and partitions of finite point sets. This type of questions are also related to so-called colorful theorems in convexity.

Speaker: Masanori Sawa (Nagoya University)

Title: An approach to the existence problem of minimal formula based on the Larman-Rogers-Seidel theorem

Abstract: Cubature formula is a numerical integration of a function f, stated as a weighted average of the function values of f at specified points in the space. Many researchers in various areas have long considered the existence problem of multidimensional cubataure formula, minimal with respect to the Möller bound, for a particular class of integrals called spherically symmetric integral. In this talk we review backgrounds and some basic facts anout the present problem with special emphasis on the degree $4k+1$ case. We present a new necessary condition for such a formula to exist by unifying the Mysovskikh theory and Nozaki's generalization of the Larman-Rogers-Seidel theorem. Moreover by using the new condition, we will show there

exists no minimal formula of degrees 13, 17, 21 for a special integral on which Xu (1998) focused from the analytic point of view.

Speaker: Suh-Ryung Kim (Seoul National University)

Title: On competition numbers of graphs

Abstract: The competition graph of a digraph D is a graph which has the same vertex set as D and has an edge between two distinct vertices x and y if and only if there exists a vertex v in D such that (x, v) and (y, v) are arcs of D. For any graph G, G together with sufficiently many isolated vertices is the competition graph of some acyclic digraph. The competition number $k(G)$ of a graph G is defined to be the smallest number of such isolated vertices. In general, it is hard to compute the competition number $k(G)$ for a graph G and characterizing a graph by its competition number has been one of important research problems in the study of competition graphs.

In this talk, we survey results on competition numbers of graphs especially focusing on the 30-year old Opsut conjecture that for a locally cobipartite graph G, $k(G) \leq 2$ and the equality holds if and only if $\theta_G(N_G(v)) = 2$ for any vertex v of G.

Speaker: Boram Park (Seoul National University)

Title: On Opsut's conjecture for hypercompetition numbers of hypergraphs

Abstract: The notion of a competition hypergraph was introduced by Sonntag and Teichert (2004) as a variant of a competition graph. The competition hypergraph $\mathcal{CH}(D)$ of a digraph D is the hypergraph such that the vertex set is the same as D and $e \subset V(D)$ is a hyperedge if and only if e contains at least 2 vertices and e coincides with the in-neighborhood of some vertex v in the digraph D. For any hypergraph $\mathcal{H}$, $\mathcal{H}$ with sufficiently many isolated vertices is the competition hypergraph of an acyclic digraph. The hypercompetition number $hk(\mathcal{H})$ of a hypergraph $\mathcal{H}$ is defined to be the smallest number of such isolated vertices.

In this talk, we present a hypercompetition number version of Opsut's conjecture stating that for a hypergraph $\mathcal{H}$, if $\deg_{\mathcal{H}}(v) \leq 2$ for any vertex v of $\mathcal{H}$, then $hk(\mathcal{H}) \leq 2$ and that the equality holds if and only if $\deg_{\mathcal{H}}(v) = 2$ for all vertices v of $\mathcal{H}$. Then we prove that it is true.

Speaker: Takao Komatsu (Hirosaki University)

Title: Characterization of linear recurrences associated to rays in Pascal's triangle and combinatorial identities

Abstract: We describe the recurrence relations associated to the sum of diagonal elements laying along a finite ray crossing Pascal's triangle. We describe the generating function of the sequences of such sums. We also answer Horadam's question about Chebyshev and Pell connections. Using Morgan-Voyce sequence, we establish several identitities including $F_{n+1} - iF_n = i^n \sum_{k=0}^n \binom{n+k}{2k} (-2 - i)^k$ of Fibonacci numbers, where $i = \sqrt{-1}$. Several connections with continued fractions, bivariate polynomials and finite differences are also given. (partly joint work with Hacene Belbachir (USTHB, Algeria), Laszlo Szalay (University of West Hungary)

Speaker: Manabu Oura (Kochi University)

Title: Some computations concerning to the average weight enumerators

Abstract: The average weight enumerator of degree n is, by definition, the weighted sum of the weight enumerators of all classes of Type II codes of length n. Extending this notion to the case $n \equiv 0 \pmod 4$, we discuss the rings generated by such polynomials.

Speaker: Nobuaki Obata (Tohoku University) Title: Quantum probabilistic approach to spectral analysis of networks: Some recent results

Abstract: We review basic concepts of quantum probability and discuss their applications to (asymptotic) spectral analysis of (large/growing) graphs. One-mode interacting Fock spaces, equivalent to the orthogonal polynomials, play a fundamental role in computing the spectral distributions. We introduce the new notion of join of one-mode interacting Fock spaces and derive an integral expression for the m-th moment of the associated operator. This is regarded as a generalization of the Karlin-McGregor formula, a well-known integral expression of the m-step transition probability for a nearest-neighbor random walk on the non-negative integers.

Speaker: Yoshio Sano (POSTECH)

Title: The non-bipartite integral graphs with spectral radius three

Abstract: Integral graphs were introduced by F. Harary and A. J. Schwenk in 1974. Let Γ be a (simple) graph with n vertices. The *adjacency matrix*

$A(\Gamma)$ of Γ is the $n \times n$ matrix indexed by the vertices of Γ such that $A(\Gamma)_{xy} = 1$ when x is adjacent to y and $A(\Gamma)_{xy} = 0$ otherwise. The *spectral radius* of Γ is the largest eigenvalue of the adjacency matrix of Γ. An *integral graph* is a graph whose adjacency matrix has only integral eigenvalues. In this talk, we give the classification of the connected non-bipartite integral graphs with spectral radius three, which is an extension of a result by S. Simić and Z. Radosavljević in 1995. (This is a joint work with Taeyoung Chung, Jack Koolen, and Tetsuji Taniguchi.)

Speaker: Kijung Kim (POSTECH)
Title: Disconnecting strongly-regular graphs
Abstract: We study the problem of determining the minimum number of vertices of a strongly regular graph whose removal disconnects the graph into non-singletons components. We disprove a conjecture of Brouwer from 1996 and we show the conjecture is true for some infinite families of strongly regular graphs. This is joint work with Sebastian M. Cioabă and Jack H. Koolen.

Speaker: Tsuyoshi Miezaki (Tohoku University)
Title: Conformal designs based on lattice vertex operator algebras Abstract: The concept of conformal designs based on vertex operator algebras (VOAs) is due to Höhn (2008). This concept is a natural analog of the concept of combinatorial designs or spherical designs.

Let L be an even lattice. The shells $L_m = \{x \in L \mid ||x||^2 = m\}$ of L make spherical t-designs for some t and L makes the lattice VOA V_L. So, it is natural to ask that if a relationship exists between spherical designs obtained from shells of L and conformal designs obtained from V_L.

Let L be the D_4-lattice in $\mathbb{R}^4$. It is well-known that all the non-empty shells L_m make spherical 5-designs. Here, we show that V_L make conformal 5-designs. The proof needs the fundamental equations of spherical designs.

Speaker: Heesung Shin (POSTECH)
Title: Bijections between Entringer families
Abstract: André proved that the number of down-up permutations on $\{1, 2, \ldots, n\}$ is equal to the Euler number E_n. A refinement of André's result was given by Entringer, who proved that counting down-up permutations

according to the first element gives rise to Seidel's triangle $(E_{n,k})$ for computing the Euler numbers. Sequentially, using generating function method and induction, Poupard gave several further combinatorial interpretations for $E_{n,k}$ both in down-up permutations and increasing trees. Kuznetsov, Pak, and Postnikov have given more combinatorial interpretations of $E_{n,k}$ in the model of trees. The aim of this talk is to provide bijections between the different models for $E_{n,k}$ as well as some new interpretations. In particular, we give the first explicit one-to-one correspondence between Entringer's down-up permutation model and Poupard's increasing tree model.

Speaker: Mitsugu Hirasaka (Pusan National University)
Title: Adjacency between two copies of association schemes of prime order
Abstract: One of the theorems by Burnside states that each transitive permutation group of prime degree is doubly-transitive or Frobenius. In this talk we consider a combinatorial analogue of this statement and give some sufficient conditions for a coherent configuration over two copies of association schemes of prime order to be uniquely determined.