Enumerative Combinatorics School 2014
(계수적 조합수학 스쿨 2014)

NIMS, Daejeon, Korea
April 4-6, 2014

http://ec.combinatorics.kr/2014

Host National Institute for Mathematical Sciences
Sponsor 2014 NIMS School

Enumerative Combinatorics School 2014 (ECS2014)

NIMS, Daejeon, Korea

April 4-6, 2014

Enumerative Combinatorics School 2014
계수적 조합수학 스쿨 2014 안내

0 홈페이지

○ http://ec.combinatorics.kr/2014

1 강연장

○ 국가수리과학연구소 2층 CAMP 대강당
주소: 대전 유성구 유성대로 1689번길 70 (전민동 463-1) KT 대덕2연구센터

2 숙소

○ 인터시티호텔
주소: 대전 유성구 온천로 92
전화번호: 042-600-6000
홈페이지: http://www.hotelinterciti.com

○ 사전등록자 중 숙박을 신청한 참가자는 본인의 이름으로 예약되어 있습니다.
홈페이지의 방배정표를 참고하시기 바랍니다.

○ 셔틀버스 시간

	4월 4일(금)	4월 5일(토)	4월 6일(일)
인터시티호텔 -> 연구소	-	08:30	08:30
연구소 -> 인터시티호텔	19:20	19:20	13:15 (대전복합터미널, 대전역)

※저녁식사 후 탑승 위치는 아래의 지도 참고
※4월 6일(일요일) 13시15분에는 대전복합터미널(고속,시외)과 대전역으로 운행합니다.

3 등록 확인

○ 등록 확인은 강연장 앞에서 하실 수 있습니다.
○ 등록 확인을 하시면 명찰과 초록집을 드립니다.

4 식사 안내

○ 조식(5일~6일) - 강연장에서 밥버거, 샌드위치, 커피 제공 (호텔에서는 제공하지 않습니다.)
○ 중식(5일~6일) - 도시락 제공(연구소 2층 구내식당)
○ 석식(4일~5일) - 아래 표 참고

날짜	4월 4일(금)	4월 5일(토)	
장소	향미락	소나무	가원
메뉴	샤브샤브	비빔밥	순두부찌개
인원	60명 이내	30명 이내	30명 이내

5 석식 장소

6 무선인터넷 & 콜택시 번호

○ 무선인터넷
- ID: CAMP
- PW: CampWirelessNetwork

○ 콜택시 번호
- 042-242-8800
- 042-586-8000

7 강연장 출입 안내

○ 강연장에 출입하기 위해서는 강연장에 올 때마다 안내데스크에서 신분증을 제출하고 방문자용 ID 카드를 받아야 합니다. 강연 후 나갈 때에는 반드시 방문자용 ID 카드를 반납해야 합니다.

○ 강연장으로 올 때에는 화살표를 따라 오시면 됩니다.

○ 그리고 출입문 통과할 때에는 아래의 그림처럼 방문자용 ID카드를 이용하면 문을 열수 있습니다.

○ 연구소와 정해진 곳 이외에는 출입할 수 없습니다.

Timetable

- April 4 (Friday)
  - – 14h00 Registration
  - 14h00 – Opening Ceremony
  - 14h00 – 15h00 Lecture SS-1
  - 15h15 – 16h45 Lecture BP-1
  - 17h00 – 18h00 Lecture SK-1
  - 18h00 – Dinner
- April 5 (Saturday)
  - 08h30 – 09h30 Breakfast
  - 09h30 – 10h30 Lecture SS-2
  - 10h45 – 12h15 Lecture JK-1
  - 12h15 – 14h00 Lunch
  - 14h00 – 15h00 Lecture SK-2
  - 15h15 – 16h45 Lecture BP-2
  - 17h00 – 18h00 Lecture SS-3
  - 18h00 – Dinner
- April 6 (Sunday)
  - 08h30 – 09h30 Breakfast
  - 09h30 – 10h30 Lecture SK-3
  - 10h45 – 12h15 Lecture JK-2
  - 12h15 – Closing Ceremony

SS-1 Enumeration of various families of labeled trees: Part I

Seunghyun Seo, *Kangwon National University*

Abstract

A labeled tree of size n is a rooted tree consisting of n nodes that are labeled by the set $\{1, \ldots, n\}$ usually. On labeled trees, we can assign various conditions, which are kinds of restrictions or generalizations. In the 1st talk, we introduce classic families of labeled trees and present the result of their enumeration.

BP-1 List coloring of a graph

Boram Park, *NIMS*

Abstract

A *proper coloring* of a graph G is a function ϕ defined on $V(G)$ such that $\phi(v) \neq \phi(w)$ for any two adjacent vertices v and w. The *chromatic number* of a graph is the smallest integer k such G admits a proper coloring ϕ such that the number of used colors $|\phi(V(G))|$ is k. A *list assignment* L of a graph G is a function defined on $V(G)$ such that for each vertex v, $L(v)$ is a finite set. For a positive integer k, for a graph G, we say G is k*-choosable* if for any list assignment L of G such that $|L(v)| = k$ for any vertex v, there is a proper coloring ϕ of G such that $\phi(v) \in L(v)$ for any vertex v. The *list chromatic number* of a graph is the smallest integer k such that G is k-choosable. We will see some results and properties of list coloring of a graph. The List Coloring Conjecture sates that the chromatic number and the list chromatic number of any line graph are the same, and we discuss their related topics as well. In addition, we discuss paintability of a graph as a generalization of the list coloring.

SK-1 Order complexes and face posets

Sangwook Kim, *Chonnam National University*

Abstract

We begin by defining the *order complex* of a poset and the *face poset* of a simplicial complex. These constructions enable us to view posets and simplicial complexes as essentially the same topological object. They link combinatorics with topology and other areas of mathematics in a deep and fundamental way. Combinatorial interest in poset topology dates back to Gian-Carlo Rota's seminal 1964 paper on the Möbius function of a partially ordered set. The Möbius number of a poset, an important combinatorial invariant, is equal to the reduced Euler characteristic of the order complex, an important topological invariant.

We will discuss various applications of poset topology in the theory of hyperplane and subspace arrangements. Some connections with graphs, groups and lattices are also discussed.

SS-2 Enumeration of various families of labeled trees: Part II

Seunghyun Seo, *Kangwon National University*

Abstract

A labeled tree of size n is a rooted tree consisting of n nodes that are labeled by the set $\{1, \dots, n\}$ usually. On labeled trees, we can assign various conditions, which are kinds of restrictions or generalizations. In the 2nd talk, we discuss the connections to other combinatorial objects such as permutations, partitions, hyperplane arrangements, parking functions, etc.

JK-1 Viennot's combinatorial theory of orthogonal polynomials

Jang Soo Kim, *Sungkyunkwan University*

Abstract

An orthogonal polynomial sequence is a family of polynomials which are orthogonal under an inner product. In this lecture we will study Viennot's combinatorial theory of orthogonal polynomials.

We will first start with definitions and basic properties of orthogonal polynomials such as 3-term recurrence relations. We then show that the moment of orthogonal polynomials can be viewed as a generating function for weighted Motzkin paths. We will see that the moments of Hermite, Charlier, and Laguerre polynomials are equal to the numbers of matchings, partitions, and permutations. If time permites, we will also consider q-analogs of these polynomials.

SK-2 Shellability and edge labelings

Sangwook Kim, *Chonnam National University*

Abstract

Shellability is a combinatorial property of simplicial and more general cell complexes, with strong topological and algebraic consequences. Shellability first appeared in the middle of the nineteenth century in Schläfli's computation of the Euler characteristic of a convex polytope. The original theory of shellability applied only to pure complexes. In the early 1990's, a nonpure simplicial complex arose in the complexity theory with topological properties somewhat similar to those of pure shellable complexes. This led Björner and Wachs to extend the theory of shellability to nonpure complexes.

Lexicographic labeling is an labeling of the edges of the Hasse diagram of a poset in a certain way which implies shellability of the order complex of the poset. Two versions of lexicographic shellability, *EL-shellability* and *CL-shellability* will be discussed with several examples.

BP-2 Alon-Tarsi Theorem

Boram Park, *NIMS*

Abstract

In 1992, N. Alon and M. Tarsi showed that counting even circuits and odd circuits of certain orientation of a graph is related to the list chromatic number of the graph. The *circuit* C of a digraph is a subset of the arc set such that for any vertex v, the indegree and the outdegree of v in the subdigraph induced by C are the same. A circuit C is *even* if $|C|$ is even, and C is *odd* if $|C|$ id odd. Alon-Tarsi Theorem states that if the number of even circuits and the number of odd circuits of an orientation D of a graph G are not the same, then the list chromatic number of G is at most (maximum out-degree of D)+1. In this class, we see the proof of Alon-Tarsi Theorem concisely, then see some results obtained by using Alon-Tarsi Theorem. Brook's Theorem is one famous theorem in graph coloring, stating that the chromatic number of a graph is bounded by the maximum degree of a graph if the graph is neither a complete graph nor an odd cycle. The list version of Brook's Theorem is also true, and we could prove it by using Alon-Tarsi Theorem. In addition, if a graph G is a complete graph with odd vertices or a complete bipartite graph, we can obtain the list chromatic number of the line graph of G by using Alon-Tarsi Theorem.

SS-3 Enumeration of various families of labeled trees: Part III

Seunghyun Seo, *Kangwon National University*

Abstract

A labeled tree of size n is a rooted tree consisting of n nodes that are labeled by the set $\{1, \ldots, n\}$ usually. On labeled trees, we can assign various conditions, which are kinds of restrictions or generalizations. In the 3rd talk, we present some recent work on the enumeration of certain labeled trees.

SK-3 Recursive techniques

Sangwook Kim, *Chonnam National University*

Abstract

The recursive definition of the Möbius function of a poset provides a recursive technique for computing the reduced Euler characteristic of the order complex of a poset. More refined recursive techniques for computing the homology of a poset are discussed. A general class of posets to which these techniques can be applied, the *Cohen-Macaulay posets* or more generally the *sequentially Cohen-Macaulay posets*, are discussed. A recursive formulation of CL-shellability and the recursive techniques for computing Betti numbers are also presented.

JK-2 Linearization coefficients

Jang Soo Kim, *Sungkyunkwan University*

Abstract

For an orthogonal polynomial sequence, the nth polynomial $p_n(x)$ is of degree n. Thus we can always write $p_n(x)p_m(x)$ as a unique linear sum of these polynomials, i.e.,

$$p_n(x)p_m(x) = \sum_{\ell} a_{n,m,\ell} p_\ell(x).$$

The coefficients $a_{n,m,\ell}$ are called linearization coefficients.

In the second lecture we will show that the linearization coefficients for Hermite, Charlier Laguerre polynomials are equal to the numbers of inhomogeneous matchings, inhomogeneous partitions, and multi-derangements. If time permites, we will also consider q-analogs of these polynomials.

Registered participants

Students are denoted by $^{\varepsilon}$.

(1) Suhyung An (안수형), *Yonsei University*

(2) Soojin Cho (조수진), *Ajou University*

(3) Hyun il Choi (최현일)$^{\varepsilon}$, *Pusan National University*

(4) Jeong Ok Choi (최정옥), *GIST*

(5) Jihoon Choi (최지훈)$^{\varepsilon}$, *Seoul National University*

(6) Jungwon Choi (최정원)$^{\varepsilon}$, *Gyeonggi Science High School*

(7) Seungil Choi (최승일)$^{\varepsilon}$, *Sogang University*

(8) Seungwoo Ha (하승우)$^{\varepsilon}$, *Seoul National University*

(9) Seoungji Hong (홍성지), *Yonsei University*

(10) Seoyeon Hwang (황서연)$^{\varepsilon}$, *Ewha Womans University*

(11) Minjoo Jang (장민주)$^{\varepsilon}$, *Yonsei University*

(12) Jisu Jeong (정지수)$^{\varepsilon}$, *KAIST*

(13) Sung-Tae Jin (진성태)$^{\varepsilon}$, *Sungkyunkwan University*

(14) Hyung-rok Jo (조형록)$^{\varepsilon}$, *Pusan National University*

(15) Hyeong-Kwan Ju (주형관), *Chonnam National University*

(16) hyeonyi Jung (정현이)$^{\varepsilon}$, *Ewha Womans University*

(17) Ji-Hwan Jung (정지환)$^{\varepsilon}$, *Sungkyunkwan University*

(18) Hyeongkyu Kim (김형규)$^{\varepsilon}$, *Yonsei University*

(19) Ilhyung Kim (김일형), *Seoul National University*

(20) Jang Soo Kim (김장수), *Sungkyunkwan University*

(21) Jinha Kim (김진하)$^{\varepsilon}$, *Seoul National University*

(22) Kyoung-Tark Kim (김경탁)$^{\varepsilon}$, *Pusan National University*

(23) Minki Kim (김민기)$^{\varepsilon}$, *KAIST*

(24) Sangjib Kim (김상집), *Ewha Womans University*

(25) Sangwook Kim (김상욱), *Chonnam National University*

(26) Seonhwa Kim (김선화), *IBS-CGP*

(27) Seog-Jin Kim (김석진), *Konkuk University*

(28) Sooyeong Kim (김수영)$^{\varepsilon}$, *Sungkyunkwan University*

(29) Younjin Kim (김연진), *KAIST*

(30) DoYong Kwon (권도용), *Chonnam National University*

(31) Euntaek Lee (이은택)$^{\varepsilon}$, *Pusan National University*

(32) Hui Young Lee (이희영), *Hannam University*

(33) Hyunseok Lee (이현석)$^{\varepsilon}$, *Yonsei University*

(34) Kang-Ju Lee (이강주)$^{\varepsilon}$, *Seoul National University*

(35) Sang June Lee (이상준), *Duksung Women's University*

(36) Sang-Jin Lee (이상진), *Konkuk University*

(37) Seunghun Lee (이승훈), *KAIST*

(38) Seungjang Lee (이승장)$^{\varepsilon}$, *JEI University*

(39) SungBae Lim (임성배)$^{\varepsilon}$, *Gyeonggi Science High School*

(40) Sook Min (민숙), *Yonsei University*

(41) Sunyoung Nam (남선영)$^{\varepsilon}$, *Sogang University*

(42) Jung Seok Oh (오중석)$^{\varepsilon}$, *Seoul National University*

(43) Semin Oh (오세민)$^{\varepsilon}$, *Pusan National University*

(44) Boram Park (박보람), *NIMS*

(45) Jihye Park (박지혜)[ε], *Yeungnam University*

(46) Kwangsoo Park (박광수)[ε], *Sungkyunkwan University*

(47) Kyoungsuk Park (박경숙)[ε], *Ajou University*

(48) Sanggun Park (박상건)[ε], *Ajou University*

(49) YoungJa Park (박영자), *Yonsei University*

(50) Hojoon Ryou (류호준)[ε], *Gyeonggi Science High School*

(51) Jeong-woo Seo (서정우)[ε], *Yeungnam University*

(52) Seunghyun Seo (서승현), *Kangwon National University*

(53) Heesung Shin (신희성), *Inha University*

(54) Jaebum Sohn (손재범), *Yonsei University*

(55) Minho Song (송민호)[ε], *Sungkyunkwan University*

(56) Geewon Suh (서기원)[ε], *KAIST*

(57) Pilyoung Yoon (윤필영)[ε], *Seoul National University*

(58) Heekyung Yu (유희경), *Jecheon Girl Middle School*

(59) Hyonju Yu (유현주), *Pusan National University*