# The 37th KIAS Combinatorics Workshop

**Uni Hotel Jeju**
**Jeju, Korea**
**May 28–30, 2026**

# Contents

# 1 General Information

**Title** The 37th KIAS Combinatorics Workshop

**Date** May 28–30, 2026

**Venue** Uni Hotel Jeju, Jeju, Korea

**Homepage** `http://events.kias.re.kr/h/combinatorics`

## Invited Speakers

Linda Cook (Utrecht University)

James Davies (Leipzig University)

Woo-Seok Jung (University of Seoul)

Kang-Ju Lee (Seoul National University)

Eunsung Lim (Yonsei University)

Sang-il Oum (IBS DIMAG)

Xin Wei (IBS ECOPRO)

Xiaofan Yuan (IBS ECOPRO)

## Organizers

Jaehoon Kim (KAIST)

Jang Soo Kim (Sungkyunkwan University)

Jeong Han Kim (KIAS)

Seog-Jin Kim (Konkuk University)

Sang June Lee (Kyung Hee University)

Jongyook Park (Kyungpook National University)

Seunghyun Seo (Kangwon National University)

# 2 Schedule and Abstracts

**1st Day:** May 28 (Thursday)

**15:00–15:30** Registration and Opening

**Session A** Chair: Seog-Jin Kim

**15:30–16:10** **Sang-il Oum**. *Linear $\chi$-boundedness of graphs with no induced tree or four-cycle*

**16:10–16:30** Coffee break

**16:30–17:10** **Eunsung Lim**. *Almost interlacing rank polynomials of tagged arcs and $q$-deformed Pythagorean triples*

**17:20–17:40** Participant Introductions

**18:00–20:00** Dinner

**2nd Day:** May 29 (Friday)

**Session B** Chair: Young Soo Kwon

**09:20–10:00** **Linda Cook**. *Introducing local (distributed) certification*

**10:00–10:20** Coffee break / Group photo

**10:20–11:00** **Xiaofan Yuan**. *Color degree conditions on rainbow structures in edge-colored graphs*

**11:10–11:50** **Woo-Seok Jung**. *Comparing cluster structures on subalgebras of bosonic extensions and double Bott–Samelson varieties*

**12:00–13:30** Lunch

**14:00–17:30** Free discussion

**18:00–20:00** Banquet

**3rd Day:** May 30 (Saturday)

**Session C** Chair: Jongyook Park

**09:20–10:00** **Xin Wei**. *Separating hash families with large universe*

**10:00–10:30** Coffee break

**10:30–11:10** **Kang-Ju Lee**. *A signed graph analogue of acyclic orientation polynomials and the sink theorem*

**11:20–12:00** **James Davies**. *A survey of coarse graph theory*

**12:00–13:00** Closing / Lunch

**Speaker:** Sang-il Oum

**Affiliation:** IBS DIMAG

**Title:** Linear $\chi$-boundedness of graphs with no induced tree or four-cycle

**Abstract**

We prove that for every tree $T$, there exists $c \geq 1$ such that every graph $G$ with no induced $T$ and no induced four-cycle has chromatic number at most $c \cdot \omega(G)$. This unifies and substantially extends a number of previous results in the literature.

Joint work with Tung Nguyen.

**Speaker:** Eunsung Lim

**Affiliation:** Yonsei University

**Title:** Almost interlacing rank polynomials of tagged arcs and $q$-deformed Pythagorean triples

**Abstract**

We investigate the coefficients of rank polynomials arising from cluster algebras associated with bordered surfaces with marked points, focusing on singly and doubly notched arcs. Obtained from the $F$ polynomials of cluster variables by specializing all coefficient variables to $q$, these polynomials enumerate order ideals in certain fence posets. Our focus is on unimodality and the stronger almost interlacing property.

For any tagged arc on a bordered surface, we prove that the rank polynomial is almost interlacing. The plain arc case was previously known; the notched case is established by analyzing the loop fence posets arising from Wilson's loop graphs.

As a second application, a conjecture of Mathevet, Morier-Genoud, and Ovsienko on $q$-deformed Pythagorean triples is proved: for polynomials satisfying $A(q)^2+qB(q)^2 = C(q)C^*(q)$ with $C^*(q) = q^{\deg C}C(q^{-1})$, each has unimodal coefficients. The proof expresses these polynomials in terms of rank polynomials of specific fence posets.

**Speaker:** Linda Cook

**Affiliation:** Utrecht University

**Title:** Introducing local (distributed) certification

**Abstract**

In this talk we discuss local certification, a purely combinatorial problem inspired by fault tolerance in distributed computing networks. A local certification of a graph property is a protocol in which nodes are given "certificates of a graph property" that allow the nodes to check whether their network has this property while only communicating with their local network. The key property of a local certification is that if certificates are corrupted, some node in the network will be able to recognize this. Inspired by practical concerns, the aim in local certification is to minimize the maximum size of a certificate. One can also view local certification as a way of phrasing a distributed analog for the class NP and as a measure of how "locally" defined a graph property is.

Any graph property can be certified using $O(n^2)$ bits and simple properties like acyclicity require $\Omega(\log n)$ bits. A prominent open problem in the area is whether any minor closed property has a local certification using $O(\log n)$ bits. In this talk we introduce this open problem and discuss related joint work with Maximillian Gorsky, Tony Huynh, Eunjung Kim, Seokbeom Kim and Tomáš Masařík (U Warsaw).

**Speaker:** Xiaofan Yuan

**Affiliation:** IBS ECOPRO

**Title:** Color degree conditions on rainbow structures in edge-colored graphs

**Abstract**

Let $G = (V, E)$ be a graph on $n$ vertices, and let $c : E \to \mathcal{C}$, where $\mathcal{C}$ is a set of colors. Let $\delta^c(G) = \min_{v \in V}\{d^c(v)\}$ where $d^c(v)$ is the number of colors on edges incident to a vertex $v$ of $G$. In 2011, Fujita and Magnant showed that if $G$ is a graph on $n$ vertices that satisfies $\delta^c(G) \geq n/2$, then for every two vertices $u, v$ there is a properly-colored $u, v$-path in $G$. We show that for sufficiently large graphs $G$ the same bound for $\delta^c(G)$ implies that any two vertices are connected by a rainbow path. Specifically, we show that there exists $n_0 \in \mathbb{Z}^+$ such that, for every $n \geq n_0$, if $G$ is an edge-colored graph of order $n$ and $\delta^c(G) \geq n/2$, then any two distinct vertices are connected by a rainbow path of length at most nine. Consequently, we also give sufficient color degree conditions for the graph being rainbow $k$-connected, rainbow $k$-linked, and the existence of a rainbow subdivision of $K_k$ on arbitrary selected branch vertices, respectively.

This is joint work with Andrzej Czygrinow.

**Speaker:** Woo-Seok Jung

**Affiliation:** University of Seoul

**Title:** Comparing cluster structures on subalgebras of bosonic extensions and double Bott–Samelson varieties

**Abstract**

For a positive braid word $b$, we compare the cluster structure on a subalgebra of a bosonic extension associated with $b$ with that on the coordinate ring of the corresponding half-decorated double Bott–Samelson variety. These structures are described by two different combinatorial models, namely admissible chains of $i$-boxes and Demazure weaves. We show how admissible chains of $i$-boxes can be interpreted in terms of Demazure weaves, and use this to relate the two cluster structures. We also discuss applications of this correspondence.

This is joint work with Jisun Huh, Myungho Kim, and Euiyong Park.

**Speaker:** Xin Wei

**Affiliation:** IBS ECOPRO

**Title:** Separating hash families with large universe

**Abstract**

Separating hash families are useful combinatorial structures that generalize several well-studied objects in cryptography and coding theory. Let $p_t(N, q)$ denote the maximum size of the universe for a $t$-perfect hash family of length $N$ over an alphabet of size $q$. We show that

$$q^{2-o(1)} < p_t(t, q) = o(q^2)$$

for all $t \geq 3$, thereby resolving an open problem raised by Blackburn et al. (2008) for certain parameter ranges. Previously, this result was known only for $t = 3$ and $t = 4$. Our approach establishes the existence of a large set of integers that avoids nontrivial solutions to a system of correlated linear equations.

This is joint work with Xiande Zhang and Gennian Ge.

**Speaker:** Kang-Ju Lee

**Affiliation:** Seoul National University

**Title:** A Signed Graph Analogue of Acyclic Orientation Polynomials and the Sink Theorem

**Abstract**

We introduce the acyclic orientation polynomial of a signed graph, defined as the generating function that counts sinks of its acyclic orientations, thereby refining the number of acyclic orientations. We prove that our acyclic orientation polynomial satisfies the deletion–contraction recurrence with the recurrence rule depending on the sign of the edge involved. Using this recurrence, we expand the polynomial in terms of its subgraphs as an analogue of the expansion of the chromatic polynomial. The main application is an alternative proof of the signed graph analogue of Stanley's sink theorem for chromatic symmetric functions, which does not rely on a signed version of quasi-symmetric functions and $P$-partitions.

**Speaker:** James Davies

**Affiliation:** Leipzig University

**Title:** A survey of coarse graph theory

**Abstract**

Many graphs and metric spaces have a much simpler "coarse" structure in which distances are only slightly distorted. We survey the blossoming area of coarse graph theory that aims to find such simpler coarse structures.

# 3 List of Participants

1. Baek, Ingyu (Yonsei University)
2. Chae, Jihyo (Yonsei University)
3. Chang, Yeonsu (Hanyang University)
4. Cho, Minho (KIAS)
5. Choi, Mujin (KAIST & IBS DIMAG)
6. Choi, Wan Su (Seoul National University)
7. Chu, Hojin (KIAS)
8. Cook, Linda (Utrecht University)
9. Daimari, Nightingale (Sungkyunkwan University)
10. Davies, James (Leipzig University)
11. Dolores, Eric (Yonsei University)
12. Dong, Zichao (IBS ECOPRO)
13. Eom, Taehyun (GIST)
14. Geng, Zihao (Kyungpook National University)
15. Hong, Taehee (Seoul National University)
16. Huynh, Tony (IBS DIMAG)
17. Hwang, Byung-Hak (KIAS)
18. Im, Seonghyuk (KIAS)
19. Jung, Woo-Seok (University of Seoul)
20. Kim, Boran (Kyungpook National University)
21. Kim, Eunjung (KAIST / IBS DIMAG)
22. Kim, Gunwoo (KAIST & IBS DIMAG)
23. Kim, Hyobeen (Chonnam National University)
24. Kim, Jang Soo (Sungkyunkwan University)
25. Kim, Jeong Han (KIAS)
26. Kim, Jinha (Chonnam National University)
27. Kim, Minki (GIST)

28. Kim, Minseo (KAIST)
29. Kim, Ringi (Inha University)
30. Kim, Sangwook (Chonnam National University)
31. Kim, Seog-Jin (Konkuk University / KIAS)
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33. Kwon, Young Soo (Yeungnam University)
34. Lee, Ho-hyeong (Yonsei University)
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42. Liu, Jing (Shandong University & Sungkyunkwan University)
43. Liu, Pei (Sungkyunkwan University)
44. Liu, Yuxiang (Kyungpook National University)
45. Manaloto, Korina Ernjulie (Kyungpook National University)
46. Oh, Jaeseong (Sungkyunkwan University)
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51. Park, Jongyook (Kyungpook National University)
52. Park, Wonjung (Yonsei University)
53. Pervin, Jesmina (Kyungpook National University)
54. Rivera Omana, Fernanda (University of Waterloo)
55. Seo, Seunghyun (Kangwon National University)

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57. Shin, Heesung (Inha University)
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59. Wei, Xin (IBS ECOPRO)
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61. Yoo, Meesue (Chungbuk National University)
62. Yoo, Semin (IBS DIMAG)
63. Yuan, Xiaofan (IBS ECOPRO)
64. Zhang, Yanting (Northwestern Polytechnical University)