Table of Contents

Day 1 (Dec. 10 Wednesday)

Day 2 (Dec. 11 Thursday)

Day 3 (Dec. 12 Friday)

2014 KAIST CMC Annual Lecture Series

Theory of excluding induced subgraphs

Paul Seymour, Princeton University
Maria Chudnovsky, Columbia University

Lecture 1:	Dec. 11, 10:30AM-12PM
Lecture 2:	Dec. 11, 1:30PM-3PM
Lecture 3:	Dec. 12, 10:30AM-12PM
Lecture 4:	Dec. 12, 1:30PM-3PM

Room 1501, Building E6-1, KAIST

This will be a series of four lectures, beginning with a general introduction to the area of induced subgraphs, and later focusing on several recent results. We will examine the structure of graphs that do not contain certain induced subgraphs, and in particular study relations between the clique number, stability number and chromatic number of these graphs. Later topics will include the strong perfect graph theorem, and recent progress on the Erdős-Hajnal conjecture, and on various conjectures of Gyárfás.

Abstracts

Invited Talk	Dec. 10, 2PM-2:30PM (Room 1409)

A variation of list coloring and its properties

Young Soo Kwon (Yeungnam University)

In this talk, we introduce a variation of list coloring. It is in some sense a mixed coloring of ordinary coloring and list coloring. For a given graph G and for any positive integers k and t with $k \geq t$, a list assignment $\{L(v)\}$ is called (k,t)-list if for any vertex v, $|L(v)| = k$ and there exist t colors $c_1, \ldots, c_t$ such that $c_i \in L(u)$ for any $i = 1, \ldots, t$ and for any $u \in V(G)$. A graph G is called (k,t)-list colorable if for any (k,t)-list L of G, there is a proper vertex coloring ϕ such that for any $u \in V(G)$, $\phi(u) \in L(u)$. For a fixed positive integer t, t-list chromatic number $\chi_t(G)$ is defined by the minimum number k so that G is (k,t)-list colorable. One may easily know that for $t = \chi(G) - 1$ or $\chi(G)$, $\chi_t(G) = \chi(G)$. In this talk, we consider several properties of the list colorings defined above. We show that for any positive integers i and ℓ with $i \leq \ell$ and for any $i-2$ integers $a_1, \ldots, a_{i-2}$ such that $i \leq a_{i-2} \leq \cdots \leq a_1 \leq \ell$, there exists a graph G such that $\chi(G) = i$, $ch(G) = \ell$ and for any $j = 1, \ldots, i-1$, $\chi_j(G) = a_j$.

Invited Talk	Dec. 10, 2:40PM-3:10PM (Room 1409)

Small topics on association schemes

Mitsugu Hirasaka (Pusan National University)

Coherent configurations and association schemes are used as tools to connect some combinatorial objects to finite-dimensional algebras. We introduce an algebraic definition of them to summarize our main interests in the study of association schemes. And we focus on some classes of association schemes with a fixed set of small valencies and show several results on automorphsim groups of such association schemes.

Coffee Break	Dec. 10, 3:10PM-3:40PM

Invited Talk	Dec. 10, 3:40PM-4:10PM (Room 1409)

On Extremal Combinatorial Problems of Noga Alon

Younjin Kim (KAIST)

Extremal combinatorics is a field of combinatorics, which aims to determine or estimate the maximum or minimum possible cardinality of a collection of finite objects (numbers, graphs, vectors, sets, etc.) that satisfy certain requirements.

In 1991, Alon, Babai and Suzuki conjectured that if $n \geq s + \max_{1 \leq i \leq r} k_i$, then $|\mathcal{F}| \leq \binom{n}{s} + \binom{n}{s-1} + \cdots + \binom{n}{s-r+1}$ when $\mathcal{F}$ is a family of subsets of $[n]$ such that $|F_i|$ (mod p) $\in K = \{k_1, k_2, \cdots, k_r\}$ for all $F_i \in \mathcal{F}$ and $|F_i \cap F_j|$ (mod p) $\in L = \{l_1, l_2, \cdots, l_s\}$ for

$i \neq j$, where K and L are disjoint subsets of $\{0, 1, \cdots p-1\}$ and p is a prime. In this talk, we prove this conjecture by using the algebraic method.

A family $\mathcal{F}$ is t-intersecting if any two members have at least t common elements. In 1961, Erdős, Ko, and Rado proved that the maximum size of a t-intersecting family of subsets of size k is equal to $\binom{n-t}{k-t}$ if $n \geq n_0(k,t)$. In 2014, Alon, Aydinian, and Huang considered families generalizing intersecting families, and proved the same bound. In this talk, we give a strengthening of their result by considering families generalizing t-intersecting families for all $t \geq 1$.

Invited Talk	Dec. 10, 4:20PM-4:50PM (Room 1409)

A new *q*-Selberg integral, Schur functions, and Young books

Jang Soo Kim (Sungkyunkwan University)
(joint work with Soichi Okada)

Recently, Kim and Oh expressed the Selberg integral in terms of the number of Young books which are a generalization of standard Young tableaux of shifted staircase shape. In this talk the generating function for Young books according to major index statistic is considered. It is shown that this generating function can be written as a q-integral which gives a new q-Selberg integral. It is also shown that the new q-Selberg integral has an expression in terms of Schur functions.

Dinner	Dec. 10, 6PM-

CMC Annual Lecture 1 —Paul Seymour	Dec. 11, 10:30AM-12PM (Room 1501)

CMC Annual Lecture 2 — Maria Chudnovsky	Dec. 11, 1:30PM-3PM (Room 1501)

Coffee Break	Dec. 11, 3:00PM-3:40PM

Invited Talk	Dec. 11, 3:40PM-4:10PM (Room 3435)

The Betti numbers of real toric varieties corresponding to generalized graph associahedra

Suyoung Choi (Ajou University)
(joint work with Boram Park, Hanchul Park and Seonjeong Park)

Given a simple graph G, the graph associahedron P_G is a convex polytope such that the facets are corresponding to the connected subgraphs of G. Graph associahedra have been studied widely and founded in a broad range of subjects. Recently, H. Park and I [1] computed the rational Betti number of the real toric variety corresponding to a graph associahedron. In order to do, they considered the simplicial poset S_G all of whose elements correspond to the induced subgraphs of G which only have connected components with even number many vertices, and showed that S_G is shellable.

We note that there are several generalized notions of a graph assoicahedron. Two of them are a nestohedron and a pseudograph associahedron. In this talk, we discuss whether the arguments in [1] is applicable to these generalizations or not. These works in progress are partially joint with Hanchul Park (KIAS), and partially joint with Boram Park (Ajou University) and Seonjeong Park (NIMS).

[1] S. Choi and H. Park, A new graph invariant arises in toric topology, to appear in *J. Math. Soc. Japan*, see arXiv:1210.3776.

Invited Talk	Dec. 11, 4:20PM-4:50PM (Room 3435)

Regular subgraphs in uniform hypergraphs

Jaehoon Kim (University of Birmingham)

We prove that for every integer $r \geq 2$, there exist a constant c and a function $n(k)$ such that for any k, n with $k \geq cr$, $n \geq n(k)$, an n-vertex k-uniform hypergraph H containing no r-regular subgraphs has at most $(1+o(1))\binom{n-1}{k-1}$ edges. Moreover, we show stability result saying that if H contains at least $(1-o(1))\binom{n-1}{k-1}$ edges, then there is a vertex contained in almost all edges. We also show the following exact result for $r = 3, 4$: if $r = 3, 4$ there exist $k'(r), n'(k)$ such that an n-vertex k-uniform hypergraph H with no r-regular subgraph satisfying $k \geq k'(r), n \geq n'(k)$, and $r \mid k$ contains at most $\binom{n-1}{k-1}$ edges, and equality holds if and only if H is a full-k-star, that is, a hypergraph consisting of all $\binom{n-1}{k-1}$ distinct edges containing a given vertex.

Invited Talk	Dec. 11, 5PM-5:30PM (Room 3435)

On choosability with separation of planar graphs with forbidden cycles

Ilkyoo Choi (KAIST)
(joint work with Bernard Lidický and Derrick Stolee)

We study a refined version of list coloring of graphs, also known as choosability with separation. A (k, d)-*list assignment* L of a graph G is a function that assigns to each vertex v a list $L(v)$ of at least k colors and for any adjacent pair uv, the lists $L(u)$ and $L(v)$ share at most d colors. A graph G is (k, d)-choosable is there exists an L-coloring of G for every (k, d)-list assignment L. In 2001, Škrekovski asked if all planar graphs are $(3, 1)$-choosable, and to our knowledge, there are no partial results towards this conjecture. We provide the first positive evidence of this conjecture by proving that planar graphs without 4-cycles are $(3, 1)$-choosable, and also that planar graphs without 5-cycles and 6-cycles are $(3, 1)$-choosable. In addition, we give an alternative and slightly stronger proof that triangle-free planar graphs are $(3, 1)$-choosable, which was a previous result by Kratochvíl, Tuza, and Voigt.

Banquet for CMC Annual Lecture Series	Dec. 11, 6PM-

CMC Annual Lecture 3 — Paul Seymour	Dec. 12, 10:30AM-12PM (Room 1501)

CMC Annual Lecture 4 — Maria Chudnovsky	Dec. 12, 1:30PM-3PM (Room 1501)

Coffee Break	Dec. 12, 3:00PM-3:30PM

Invited Talk	Dec. 12, 3:30PM-4:30PM (Room 1501)

Planar graph emulators — Beyond planarity in the plane

Petr Hliněný (Masaryk University)

Two beautiful and mutually related mathematical puzzles are introduced; the planar covering problem of Negami, and the planar emulator problem of Fellows. In a nutshell, both these very similar problems study a question how to represent non-planar graphs by larger planar graphs which "look locally the same" as the original non-planar graphs. During nearly 30 years of study, many strong particular results have been reached but the problems still remain wide open. Besides the current state-of-art of Negami's planar cover conjecture, we pay particular attention to Fellows' planar emulator problem which for long time stayed in the shadow of the planar covering problem, until a breakthrough result of Rieck and Yamashita 6 years ago which triggered a rapid recent development in planar emulators.

Dinner	Dec. 12, 6PM-

Index