IMBM Discrete Mathematics Days, May 4-5

Below you may find the abstracts of the talks for IMBM Discrete Mathematics Days to be held on May 4-5, 2019. The daily program can also be found in last two pages. Please visit the relevant web page:

`https://sites.google.com/site/umitislak/imbm_discrete_math_days_2019`

for possible changes. We would like to express our gratitude to Istanbul Matematiksel Bilimler Merkezi for all the support they provided.

Organization Committee: Fatih Demirkale, Ümit Işlak

Scientific Committee: Aysel Erey, Müge Taşkın Aydın, Tınaz Ekim Aşıcı, Selda Küçükçifçi, Kağan Kurşungöz, Sibel Özkan, Şule Yazıcı

ABSTRACTS

Oktay Ölmez - Ankara University, Ankara, Turkey.

Directed Strongly Regular Graphs A regular directed graph of degree k with n vertices is a directed strongly regular graph (dsrg) on the parameters (n, k, t, λ, μ); if the number of directed paths of length two from any vertex v to any vertex w is exactly λ if $v \mapsto w$; exactly t if $v = w$ (this may be interpreted as the number of bidirected edges adjacent to any vertex), and exactly μ otherwise (i.e., when there is no edge from v to w; even though there may be an edge from w to v).

In this talk, we will examine some construction methods and properties of dsrg's. We will specifically focus on Cayley directed strongly regular graphs.

Zafeirakis Zafeirakopoulos - Gebze Technical University, İstanbul, Turkey.

A brief history of partition analysis Partition analysis is a tool introduced by MacMahon in the beginning of last century. MacMahon's motivation was to solve integer partition problems, in particular to compute the generating function of partitions under linear constraints. Nevertheless, the method can be applied to any linear Diophantine problem. Due to the decline of concrete mathematics for half a century, partition analysis almost disappeared. In the last 5 decades though, interest was renewed because of the wide range of applications and the progress in generating function methods. Different lines of research arose from combinatorics to constraint programming. We will review these lines of research and present a unified geometric point of view.

Gökhan Yıldırım - Bilkent University, Department of Mathematics, Ankara, Turkey.

On Hammersley's process and its variations The longest increasing subsequence problem for random permutations has motivated many interesting research directions at the intersection of probability, combinatorics, statistical physics and theoretical computer science in the last fifty years. In 2006, M. H. Albert considered a generalization of this problem in the context of permutation-patterns and obtained some results.

In this talk, first I will review some existing results related to the classical case such as patience-sorting algorithm, Hammersley's interacting particle process, and RSK correspondence. Then I will discuss some open problems in the context of the generalized version of the problem and present some initial results. *The talk is based on ongoing work with A. Kerimov.*

Kağan Kurşungöz - Sabancı University, Department of Mathematics, İstanbul, Turkey.

Some Inverse Problems in Computer Algebra Computer algebra has become a tool for facilitating combinatorial, number theoretic, algebraic, geometric ... proofs. Computers can even produce fully-fledged proofs, especially in the theory of special functions. We will first review some major developments in computer algebra in the last century, then introduce a type of inverse problem to the current theory. As time allows, we will go over concrete examples.

Elnur Emrah - KTH Royal Institute of Technology, Sweden

First-order asymptotics for the inhomogeneous exponential corner growth model

We revisit the exactly solvable corner growth model with independent exponential waiting times. The rates of the exponentials are given by an addivitely separable function of the site coordinates rendering the model equivalent to the TASEP with step initial condition and particlewise/holewise disorder. The law of large numbers and fluctuations of the growth process have been studied under a diverse set of assumptions on the rate assignments. In this work, we consider a sufficiently general manner of assigning rates that covers many variants of the model from the literature. We obtain simple explicit variational formulas for the first-order asymptotics of the growth process under a decay condition on the rates. Subject to further mild conditions, we prove the existence of the limit shape, describe it expliclity observing geometric features such as potential flat segments and spikes near the axes.

İlker Arslan - Mef University, Department of Mathematics, İstanbul, Turkey.

Unfair Permutations In a game of n players, the kth player picks k numbers uniformly and independently from $(0, 1)$ and chooses the maximum of these k numbers. If R_k is the rank of the kth player, then we obtain a permutation $(R_1, R_2, ..., R_n)$ of $\{1, 2, ..., n\}$. The way we obtain this permutation, which is called as unfair permutation, gives a distribution on the set of permutations S_n. In this talk, a comparison between uniformly distributed permutations and unfair permutations together with a few results and observations on some statistics, such as number of (generalized) descents, number of inversions and number of fixed points, will be presented. Furthermore, a generalization of unfair permutations will be given.

Oğuz Gürerk - Boğaziçi University, Istanbul, Turkey.

Random permutation graphs For a given permutation π in S_n, a random permutation graph is formed by including an edge between two vertices i and j if and only if $(i-j)(\pi(i)-\pi(j)) < 0$. I will talk about various statistics of random permutation graphs. The problems of interest will be on the number of isolated vertices, the distribution of a given node, the number of records etc. If time permits, I will introduce variations/generalizations of the model using the concept of unfair permutations.

Yusuf Hakan Kalaycı - Boğaziçi University, Department of Computer Engineering, Istanbul, Turkey.

Operation Region of Algorithmic LLL The groundbreaking work of Moser-Tardos take a huge step to make the powerful combinatorial tool of Lovasz Local Lemma constructive. Recent studies investigate the limitations of the algorithm. One such study of Kolipaka and Szegedy showed that operation region of the algorithmic version goes beyond the theoretical one. In the talk, we will see some recent studies involving the gap and list open problems.

Uğur Odabaşı - İstanbul University, İstanbul, Turkey.

The Integer-antimagic Spectra of Disjoint Union of Hamiltonian Graphs Let A be a non-trivial abelian group. A connected simple graph $G = (V, E)$ is A-*antimagic*, if there exists an edge labeling $f : E(G) \to A\backslash\{0\}$ such that the induced vertex labeling $f^+(v) = \sum_{uv \in E(G)} f(uv)$ is a one-to-one map. The *integer-antimagic spectrum* of a graph G is the set $\mathrm{IAM}(G) = \{k : G \text{ is } \mathbb{Z}_k\text{-antimagic and } k \geqslant 2\}$. In this talk, we will determine the integer-antimagic spectra for disjoint union of Hamiltonian graphs.

Lale Özkahya - Hacettepe University, Department of Computer Engineering, Ankara, Turkey

Maximum Hypergraphs without containing a forbidden structure In this talk, we will briefly survey recent developments on extremal hypergraphs that do not contain a forbidden structure, in particular a cycle of a fixed length. We will present the methods used on estimating bounds on the size of these hypergraphs and, if time permits, present applications of more recent methods used in extremal graph theory such as container method.

Aysel Erey - Gebze Technical University, İstanbul, Turkey.

Chromatic and Independence Polynomials. The chromatic polynomial counts the number of proper colorings of a graph and the independence polynomial is the generating function for the number of its independent sets. These two polynomials have been of great interest in graph theory. In this talk I will first give a brief overview of the study of such polynomials and then I will discuss some recents results about extremal problems for the enumeration of colorings and independent sets.

Tınaz Ekim - Boğaziçi University, İstanbul, Turkey.

2012 Nobel Prize in Economics and Matching Theory The Nobel Prize in Economic Sciences 2012 was awarded jointly to A. E. Roth and L. S. Shapley "for the theory of stable allocations and the practice of market design." The reason why it was awarded to A. E. Roth and L. S. Shapley is two-fold: their extremely valuable efforts in applying scientific findings in very important real life problems such as kidney donation and student placement problems, and their contribution to the theory of stable matchings. This Nobel Prize has been widely covered in Turkish media not only because of its important applications but also because there were a number of Turkish researchers whose work was extensively cited in the official article, published by the Royal Swedish Academy of Science, where the scientific background of this prize is explained. In this talk, we will present the theory of stable matchings starting from the basics such as the Gale-Shapley Algorithm, discussing more advanced topics such as manipulation and existence of stable matchings under various conditions. Two important applications, namely kidney exchange and student placement problems will be given special consideration. In the second part of the talk, the role of graph theory in stable matchings will be discussed in more depth. In particular, the links between stable matchings and the problem of finding an inclusion-wise maximal matching of minimum size will be explored. As a natural consequence of this link, the need for studying various graph classes will be emphasized.

Michel Lavrauw - Sabancı University, Department of Mathematics, İstanbul, Turkey.

Arcs in projective spaces and tensors over finite fields An arc in a projective space over a finite field is a set of points, each subset of which is as independent as possible. Examples include conics and, more generally, normal rational curves. The study of arcs has been one of the central themes in Finite Geometry since the fundamental work Galois Geometry by Beniamino Segre, and was further stimulated by the one-to-one correspondence between arcs and linear maximum distance separable codes (MDS codes). The MDS conjecture (open since 1950's) states that when the dimension of a GF(q)-linear MDS codes is between 3 and q-1 then its length can be at most q+1. We report on recent progress towards a proof of this conjecture, based on joint work with Simeon Ball.

Mehmet Akif Yıldız - Boğaziçi University, Istanbul, Turkey.

Defective Ramsey Numbers A *k-sparse i-set* is a set S of i vertices of a graph G such that each vertex in S has degree at most k in G. A *k-dense j-set* is a set D of j vertices of a graph G such that each vertex in D has degree at most k in the complement of G; in other words, each vertex in D misses at most k other vertices in its neighborhood. The term $k-$defective is used to denote a k-sparse or k-dense set.

As a generalization of classical Ramsey numbers, $R_k^{\mathcal{G}}(i,j)$ is defined as the smallest natural number n such that every graph in the class $\mathcal{G}$ on n vertices has either a k-dense i-set or a k-sparse j-set. Note that the case $k=0$ corresponds to the classical Ramsey numbers. The talk will be about some partial results on $R_k^{\mathcal{G}}(i,j)$ when $\mathcal{G}$ represents perfect graphs, or some of its subclasses such as cographs and split graphs.

This is joint work with Tınaz Ekim, John Gimbel and Oylum Şeker.

Barış Can Esmerci - Boğaziçi University, Department of Computer Engineering, Istanbul, Turkey.

Longest Common Subsequence (LCS) of Random Permutations The talk will be about a conjecture on the expected length of the longest common subsequence of two i.i.d. random permutations. We will show that uniform distribution is not the minimizer of this expectation and prove a lower bound.

PROGRAM

May 4, Saturday

09:00-09:30 Registration

09:30-09:45 Opening Talks

Session I

09:45-10:30 Oktay Ölmez (Ankara)

10:30-11:15 Zafeiriakis Zaferoupoulos (Gebze Teknik)

11:15-12:00 Gökhan Yıldırım (Bilkent)

12:00-13:30 Lunch

Special Lecture

13:30-14:30 Kağan Kurşungöz (Sabancı)

Session II

14:30-15:15 İlker Arslan (MEF)

15:15-15:30 Coffee Break

15:30-16:15 Michel Lavrauw (Sabancı)

16:15-16:40 Oğuz Gürerk (Boğaziçi) - Student speaker

16:40-17:05 Yusuf Hakan Kalaycı (Boğaziçi) - Student speaker

May 5, Sunday

Session III

09:45-10:30 Uğur Odabaşı (İstanbul)

10:30-11:15 Lale Özkahya (Hacettepe)

11:15-12:00 Aysel Erey (Gebze Teknik)

12:00-13:30 Lunch

Special Lecture

13:30-14:30 Tınaz Ekim (Boğaziçi)

Session IV

14:30-15:15 Elnur Emrah (KTH)

15:15-15:30 Coffee Break

15:30-15:55 Mehmet Akif Yıldız (Boğaziçi) - Student Speaker

15:55-16:20 Barış Can Esmer (Boğaziçi) - Student Speaker

17:00 Dinner at XX at YY (XX and YY are still random variables)