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Abstracts

Maria Chudnovsky
Coloring graphs with forbidden induced subgraphs

Abstract: The problem of testing if a graph can be colored with a given number k of colors is NP-complete for every k>2. But what if we have more information about the input graph, namely that some fixed graph H is not present in it as an induced subgraph? It is known that the problem remains NP-complete even for k=3, unless H is the disjoint union of paths. We consider the following two questions: 1) For which graphs H is there a polynomial time algorithm to 3-color (or in general k-color) an H-free graph? 2) For which graphs H are there finitely many 4-critical H-free graphs? This talk will survey recent progress on these questions, and in particular give a complete answer to the second one.

Christoph Dürr
An adversarial model for optimization and testing

Abstract: One practical difficulty in computing a solution to some combinatorial optimization problem is that the data might be known only within some interval of uncertainty. In some cases it might be possible to tests specific variables of the input and obtain their exact value. A natural task in this model is to minimize the number of tests until it is possible to produce an optimal solution. This problem has been addressed in the context of computing a minimum spanning tree for a graph where edge weights are given within some uncertainty intervals, but also for the knapsack problem and a single-machine scheduling problem. In the later the processing time of a job can potentially be reduced (by an a priori unknown amount) by testing the job. Testing a job j takes one unit of time and may reduce its processing time from the given upper limit $\bar{p}_j$ (which is the time taken to execute the job if it is not tested) to any value between 0 and $\bar{p}_j$. This setting is motivated e.g. by applications where a code optimizer can be run on a job before executing it. This talk with be a gentle introduction into this new model, reveal key algorithmic ideas and present more in detail the later scheduling problem.

Marcos Kiwi
The Random Hyperbolic Graph Model

Abstract: Random hyperbolic graphs (RHG) were proposed rather recently (2010) as a model of real-world networks. Informally speaking, they are like random geometric graphs where the underlying metric space has negative curvature (i.e., is hyperbolic). In contrast to other models of complex networks, RHG simultaneously and naturally exhibit characteristics such as sparseness, small diameter, non-negligible clustering coefficient and power law degree distribution. We will give a slow pace introduction to RHG, explain why they have attracted a fair amount of attention and then survey most of what is known about this promising infant model of real-world networks.

Monique Laurent

Combinatorial and algorithmic properties of Robinsonian matrices

Abstract: Robinsonian matrices are structured matrices that have been introduced in the 1950's by the archeologist W.S. Robinson for chronological dating of Egyptian graves. A symmetric matrix is said to be Robinsonian if its rows and columns can be simultaneously reordered in such a way that the entries are monotone nondecreasing in the rows and columns when moving toward the main diagonal. Robinsonian matrices can be seen as a matrix analog of unit interval graphs, which are precisely the graphs having a Robinsonian adjacency matrix. We will discuss several aspects of Robinsonian matrices: links to unit interval graphs; new efficient combinatorial recognition algorithm based on Similarity-First Search, a natural extension to weighted graphs of Lex-BFS; structural characterization by minimal forbidden substructures; and application to tractable instances of the Quadratic Assignment Problem.

Claudia Linhares-Sales

b-colorings: an structural overview

Abstract: A b-coloring of a graph G is a proper coloring such that every color class has a vertex with neighbors in each other color class. The b-chromatic number of G is the maximum integer k such that G admits a b-coloring with k colors. This parameter was introduced by Irving and Manlove in 1999. In that work, they proved that the related decision problem is NP-complete while polynomial on trees. In this talk, we start by relating the b-chromatic number of G with its other chromatic numbers issued of other heuristics. Then, we recall some structural properties of graphs which directly impact their b-chromatic number and other related parameters, such as girth, maximum degree, m-degree and forbidden subgraphs. In particular, we are going to see how the good structural behavior of product of graphs impact some parameters related to b-colorings. We finish this talk by showing two recently defined b-colorings parameters, namely b-homomorphism and partial b-coloring and some of their open problems of general interest.

Martin Milanič

Reconstructing perfect phylogenies via binary matrices, branchings in DAGs, and a generalization of Dilworth's theorem

Abstract: A perfect phylogeny is a rooted tree representing the evolutionary history of a set of n objects. The objects bijectively label the leaves of the tree and there are m binary characters, each labeling exactly one edge of the tree. For each leaf, the set of characters that appear on the unique root-to-leaf path is the set of characters taking value 1 at the object labeling the leaf. While every perfect phylogeny naturally corresponds to an n x m binary matrix having objects as rows and characters as columns, the perfect phylogeny problem asks the opposite question: Does a given binary matrix correspond to a perfect phylogeny? The problem is well known to be polynomially solvable: the yes instances are characterized by the absence of pairs of conflicting columns, where two columns of a binary matrix are said to be in conflict if there exist three rows on which the two columns read 11, 10, and 01, respectively. The perfect phylogeny problem and various generalizations of it -many of which were proved intractable- have been extensively studied in computational biology. We will discuss two generalizations of the perfect phylogeny problem, first considered by Hajira-souliha and Raphael in 2014 and motivated by applications in cancer genomics. Both problems are optimizations problems and can be defined as follows: The minimum conflict-free row split (MCRS) problem: split each row of a given binary matrix into a bitwise OR of a set of rows so that the resulting matrix has no pairs of conflicting columns (that is, it corresponds to a perfect phylogeny) and has the minimum number of rows among all matrices with this property. The minimum distinct conflict-free row split problem: the variant of the problem in which the task is to minimize the number of distinct rows of the resulting matrix.

The talk will focus on various graph theoretic and computational aspects of the two problems, including: formulations of the two problems in terms of branchings in a derived directed acyclic graph, a related characterization of cocomparability graphs, inapproximability results and approximation algorithms for the two problems, two polynomial time heuristic algorithms for the MCRS problem: an algorithm based on coloring cocomparability graphs, and an improvement of it that finds an optimal solution in a reduced search space via a new min-max result in weighted acyclic digraphs generalizing Dilworth's theorem.

The results presented in the talk were obtained in collaborations with Ademir Hujdurović, Edin Husić, Urša Kačar, Bernard Ries, Romeo Rizzi, and Alexandru I. Tomescu.

Fabio Protti
A general framework for path convexities

Abstract: In the study of graph convexities, a special interest is devoted to the so-called "path convexities", defined over special collections of paths. For example, the collection of the shortest paths in a graph is associated with the well-known geodesic convexity, while the collection of the induced paths is associated with the monophonic convexity; and there are many other examples. In this work we propose a general path convexity framework, of which most existing path convexities can be viewed as particular cases. Some benefits of the proposed framework are the systematization of the algorithmic study of related problems and the possibility of defining new convexities not yet investigated. This is joint work with J. V. C. Thompson, L. T. Nogueira, R. S. F. Bravo, M. C. Dourado, and U. S. Souza.

Dieter Rautenbach
Restricted Types of Matchings

Abstract: We present new results concerning restricted types of matchings such as uniquely restricted matchings and acyclic matchings, and we also consider the corresponding edge coloring notions. Our focus lies on bounds, exact and approximative algorithms. Furthermore, we discuss some matching removal problems. The talk is based on joined work with J. Baste, C. Lima, L. Penso, I. Sau, U. Souza, and J. Szwarcfiter.

Alexander Schrijver
The Partially Disjoint Paths Problem

Abstract: The partially disjoint paths problem asks for paths $P_1, ..., P_k$ between given pairs of terminals, while certain pairs of paths P_i, P_j are required to be disjoint. With the help of combinatorial group theory, we show that, for fixed k, this problem can be solved in polynomial time for planar directed graphs. We also discuss related problems. No specific foreknowledge is required.

András Sebö

Matchings, Matroids and Polyhedra for Approximating the Traveling Salesman Problem

Abstract: During the last five years, a series of improvements have been made concerning approximation algorithms for the Traveling Salesman Problem: for the special case of distance metrics of graphs (graph-TSP), for the generalization where the salesman starts from and arrives at different fixed vertices (general s-t-path TSP), and for proving some weaker versions of the forty years old "general, four-third-approximation-and-gap conjecture" (uniform covers by tours).

While Matching Theory is a usual tool for the TSP, in the most recent improvements two other pillars of combinatorial optimization appeared: matroids (intersection and union), and polyhedra, in a new way, providing links between the TSP and classical, exact combinatorial optimization.

In this talk I wish to tell some successful ideas, report about our most recent improvements and mention some old and new conjectures.