Workshop on Foundations of Computer Science: Combinatorial Algorithms and Discrete Structures (WFOCOS 2007)

Maresias Beach Hotel, Brazil
June 3-6, 2007

Program

Time	Sunday	Monday	Tuesday	Wednesday
8:30 - 9:30		Gábor Elek	Nicolas Schabanel	Rob Morris
9:30 - 10:30		problem session	group work	group work
10:30 - 11:00		Coffee break	Coffee break	Coffee break
11:00 - 12:00		Balázs Szegedy	Roberto Oliveira	Sóstenes Lins
12:00 - 14:00		Lunch	Lunch	Lunch
14:00 - 15:00		Martín Matamala	José Zamora Flavio Guiñez	
15:00 - 16:30		group work	group work	
16:30 - 17:00		Coffee break	Coffee break	
17:00 - 18:30		group work	group work	
18:30 - 19:00				
19:00 - 20:00	Opening problem session	Jayme Szwarcfiter	Alberto Miranda Cândida Nunes	
20:00 -	Dinner	Dinner	Dinner	

Talks

Monday, 8:30 - 9:30

Hypergraph Regularity and the Removal Lemma. A Non-Standard Approach

Gábor Elek
Rényi Institute, Hungary

Using ultrafilters and ultralimits we construct a hypergraph limit object similar to the original graph limit object of Lovász and Szegedy. Measure-theoretical observations about the hypergraph limit object leads to rather transparent proof of the Hypergraph Removal Lemma and the Hypergraph Regularity Theorem (Rödl et al., Gowers and Tao)

This is joint work with Balázs Szegedy.

Monday, 11:00 - 12:00

On the Limits of Hypergraphs

Balázs Szegedy
University of Toronto, Canada

We give an analytic approach to hypergraph theory and numerous consequences. We discuss a version of the regularity lemma for hypergraphs which follows in a natural way from our context.

This is joint work with Gábor Elek.

Monday, 14:00 - 15:00

Edge Labelings Induced by Vertex Labelings

Martín Matamala
Universidad de Chile, Chile

We call a function f a $B-$valuation of a graph G if f is an injection from the vertices of G to the set B such that, when each edge xy is assigned the label $|f(x) - f(y)|$, the resulting edge labels are distinct. Let us denote by $F(B)$ the class of all graphs admitting a B-valuation. In this talk we present some properties of the set B that are "inherited" by all the graphs in $F(B)$.

Monday, 19:00 - 20:00

Complexity Aspects of Convexity of Graphs

Jayme Luiz Szwarcfiter
Universidade Federal do Rio de Janeiro, Brazil

Let G be a graph. If $u, v \in V(G)$, a $u - v$ *geodesic* of G is a shortest path linking u and v. The *closed interval* $I[u, v]$ consists of all vertices lying in some $u - v$ geodesic of G. For $S \subseteq V(G)$, the set $I[S]$ is the union of all sets $I[u, v]$ for $u, v \in S$. We say that S is a *convex set* if $I[S] = S$. A set S is a *geodetic* if $I[S] = V(G)$. The cardinality of a minimum geodetic set of G is the *geodetic number* of G, while the cardinality of a maximum convex set of G, properly contained in $V(G)$, is the *convexity number* of G. The *convex hull* of S, denoted $I_h[S]$, is the smallest convex set containing S. A set S is a *hull set* of G if $I_h[S] = V(G)$. The cardinality of a minimum hull set of G is the *hull number* of G. In this talk, we discuss different aspects related to the computation of the above parameters. For each of them, we describe bounds, hardness results and some polynomial-time

Tuesday, 8:30 - 9:30

Progresses in the Analysis of Stochastic 2D Cellular Automata: a Study of Asynchronous 2D Minority

Nicolas Schabanel
Universidad de Chile, Chile

Cellular automata are often used to model systems in physics, social sciences, biology that are inherently asynchronous. Over the past 20 years, studies have demonstrated that the behavior of cellular automata drastically changed under asynchronous updates. Still, the few mathematical analyses of asynchronism focus on one-dimensional probabilistic cellular automata, either on single examples or on specific classes. As for other classic dynamical systems in physics, extending known methods from one- to two-dimensional systems is a long lasting challenging problem. In this paper, we address the problem of analysing an apparently simple 2D asynchronous cellular automaton: 2D Minority where each cell, when fired, updates to the minority state of its neighborhood. Our experiments reveal that in spite of its simplicity, the minority rule exhibits a quite complex response to asynchronism. By focusing on the fully asynchronous regime, we are however able to describe completely the asymptotic behavior of this dynamics as long as the initial configuration satisfies some natural constraints. Besides these technical results, we have strong reasons to believe that our techniques relying on defining an energy function from the transition table of the automaton may be extended to the wider class of threshold automata.

Joint work with Damien Regnault (CMM, U de Chile - ENS Lyon) and Éric Thierry (ENS Lyon).

Tuesday, 11:00 - 12:00

On the Mixing Time of Kac's Random Walk on Matrices

Roberto Imbuzeiro Oliveira
Instituto Nacional de Matemática Pura e Aplicada, Brazil

We consider Kac's random walk on n-dimensional rotation matrices, where each step is a random rotation in the plane generated by two randomly picked coordinates. This process has been proposed as a space-efficient way to apply random rotations to high dimensional datasets, e.g. so as to do dimensionality reduction (via the Johnson Lindenstrauss Lemma).

We will show that Kac's process mixes (in an appropriate sense) in $O(n^2 \ln n)$ steps to the uniform (Haar) measure on rotations. This is the first bound that is within a logarithmic factor of the (trivial) lower bound of $O(n^2)$. Our proof method includes a general method of independent interest that is related to the path coupling technique of Bubley and Dyer for discrete Markov chains. Other applications of this method are also presented.

Tuesday, 14:00 - 14:30

Nowhere-Zero Flows and Factors

José Zamora
Universidad de Chile, Chile

A digraph G has a nowhere-zero k-flow if there exists a flow $\phi : E(G) \to \{1, 2, \ldots, k-1\}$. It is known that cubic graphs having a nowhere-zero 4-flow are characterized by the existence of a 3-edge coloring. We extend this result giving a characterization of nowhere-zero 5-flows in cubic graphs based on the existence of special factors with an extra property for its cycles.

Tuesday, 14:30 - 15:00

Decomposition of Graphs into Disjoint Factors

FLAVIO GUIÑEZ
Universidad de Chile, Chile

Let $G = (V, E)$ be a graph and p a positive integer. Given a $p \times |V|$ integer matrix A, a p-tuple $(E_1, \ldots, E_p)$ of subsets of E is called an A-decomposition if $\{E_1, \ldots, E_p\}$ is a partition of E and for each $i = 1, \ldots, p$, the degree function of the graph (V, E_i) is the i-th row of A. We study the problem of the existence of A-decompositions of G, focusing on two parameters: the number p of rows of A and the class of graphs to which G belongs. For the class of complete and complete bipartite graphs we are particularly interested in the critical case $p = 3$, since the associated decision problem is polynomial time solvable for $p = 2$ and it has been proved to be NP-complete for p great or equal to 4.

Tuesday, 18:30 - 19:15

An Algorithm for Recognizing Pfaffian Near-Bipartite Graphs

ALBERTO ALEXANDRE ASSIS MIRANDA
Universidade Estadual de Campinas, Brazil

A matching covered graph is a nontrivial connected graph in which every edge is in some perfect matching. A matching covered graph G is near-bipartite if it is non-bipartite and there is a removable double ear R such that G-R is matching covered and bipartite. In 2000, C. Little and I. Fischer characterized Pfaffian near-bipartite graphs in terms of forbidden subgraphs. However, their characterization does not imply a polynomial time algorithm to determine whether a near-bipartite graph is Pfaffian. In this presentation, we will show such an algorithm. Our algorithm is based on an Inclusion-Exclusion Principle and uses as a subroutine an algorithm by McCuaig and by Robertson, Seymour and Thomas that determines whether a bipartite graph is Pfaffian. This inclusion-exclusion principle can be applied to other classes of graphs, as well.

Tuesday, 19:15 - 20:00

Flow Critical Graphs

CÂNDIDA NUNES DA SILVA
Universidade Estadual de Campinas, Brazil

In this talk we will introduce the concept of *k-flow-critical graphs*. These are graphs that do not admit a k-flow but a contraction of any pair of distinct vertices results in a graph that has a k-flow.

Any counterexample for Tutte's 3-Flow and 5-Flow Conjectures must be 3-flow-critical and 5-flow-critical, respectively. Thus, any progress towards establishing good characterizations of k-flow-critical graphs can represent progress in the study of these conjectures. We will present some interesting properties satisfied by k-flow-critical graphs discovered recently.

Wednesday, 8:30 - 9:30

Glauber Dynamics in High Dimensions

ROB MORRIS
Instituto Nacional de Matemática Pura e Aplicada, Brazil

Glauber dynamics on a graph G is the following process: Give each vertex of G a state, either $+$ or $-$, and a random exponential clock. When the clock of a vertex rings, the vertex changes its state to that of the majority of its neighbours (ties are broken randomly). The question is: Given an initial distribution of states, what happens to the system in the long term?

Fontes, Schonmann and Sidoravicius studied Glauber dynamics on the graph $\mathbb{Z}^d$, and proved that if the initial states are chosen independently, and $\mathbb{P}(+) \geq 1 - \varepsilon d^{-d}$, then 'fixation' occurs, i.e., every vertex is eventually $+$. In this talk I shall discuss how techniques from majority bootstrap percolation may be used to improve this bound when d is sufficiently large. This is partly joint work with József Balogh, Béla Bollobás and Vladas Sidoravicius.

Wednesday, 11:00 - 12:00

A Linear Algorithmic Proof of Lickorish-Wallace Theorem

SÓSTENES LINS
Universidade Federal de Pernambuco, Brazil

In the early 60's Wallace (1960) and independently Lickorish (1962) discovered an important way to present orientable 3-manifolds, namely, the framed link presentation. We provide a new proof of this theorem using gem theory. This proof is a starting point for a low-polynomial algorithm to actually get the framed link from a triangulation of the 3-manifold.

List of participants

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