Titles & Abstracts

Prof. Matt DeVos

Immersion for 2-regular digraphs

In this talk we will focus on the world of 2-regular digraphs, i.e. digraphs for which every vertex has indegree and outdegree equal to 2. Surprisingly, this family of digraphs behaves under the operation of immersion in a manner very similar to the way in which standard graphs behave under minors. This deep truth is best evidenced by the work of Thor Johnson, who developed an analogue of the Robertson-Seymour Graph Minor Theory for 2-regular digraphs under immersion. We will discuss some recent work together with Archdeacon, Hannie, and Mohar in this vein. Namely, we establish the excluded immersions for certain surface embeddings of 2-regular digraphs in the projective plane.

Flows in bidirected graphs

Tutte showed that for planar dual graphs G and G^*, a k-coloring of G is equivalent to the existence of a nowhere-zero k-flow in G^*. This led him to his famous conjecture that every bridgeless graph has a nowhere-zero 5-flow. Although this conjecture remains open, Seymour has proved that every such graph has a nowhere-zero 6-flow. Bouchet studied this flow-coloring duality on more general surfaces, and this prompted him to introduce the notion of nowhere-zero flows in bidirected graphs. He conjectured that every bidirected graph without a certain obvious obstruction has a nowhere-zero 6-flow. Improving on a sequence of earlier theorems, we show that every such graph has a nowhere-zero 12-flow.

Average degree in graph powers

For a graph G and a positive integer k, we let G^k denote the graph with vertex set $V(G)$ and two vertices adjacent in G^k if they have distance at most k in the original graph G. Motivated by some problems in additive number theory (which we will explain), we turn our attention to determining lower bounds on the average degree of the graph G^k when the original graph G is d-regular. We will describe fairly complete answers to this question when $k < 6$ and in general when k is congruent to 2 (mod 3). This talk represents joint work with McDonald, Scheide, and Thomassé.

Prof. Johann Makowsky

Classical graph properties and graph parameters and their definability in SOL

Intriguing graph polynomials. Why is the chromatic polynomial a polynomial? Comparing graph polynomials. Connection matrices and their use in showing non-definability.

Dr Gábor Kun

An analytic approach to CSPs

Analytic version of the dichotomy conjecture, connection to notions in discrete Fourier analysis. Proof of the Hell-Nesetril theorem using Dinur-Friedgut-Regev (on independent sets in power graphs).

Prof. Michael Pinsker

Algebraic and model-theoretic methods in constraint satisfaction

The Constraint Satisfaction Problem (CSP) of a finite or countable first-order structure S in a finite relational language is the problem of deciding whether a given conjunction of atomic formulas in that language is satisfiable in S. Many classical computational problems can be modelled this way. The study of the complexity of CSPs involves an interesting combination of techniques from universal algebra, Ramsey theory, and model theory. This tutorial will present an overview over these techniques as well as some wild conjectures.

Dr Lenka Zdeborová

Coloring random and planted graphs: Thresholds, structure of solutions, algorithmic hardness

Random graph coloring is a key problem for understanding average algorithmic complexity. Planted random graph coloring is a typical example of an inference problem where the planted configuration corresponds to an unknown signal and the graph edges to observations about the signal. Remarkably in a recent decade or two tremendous progress has been made on the problem using (principled, but mostly non-rigorous) methods of statistical physics. We will describe the methods - message passing algorithms and the cavity method. We will discuss their results - structure of the space of solutions, associated algorithmic implications, and corresponding phase transitions. We will conclude by summarizing recent mathematical progress in making these results rigorous and discuss interesting open problems.

Schedule

All lectures will take place in S6, 2nd floor, KAM, Malostranské nám. 25 unless otherwise indicated

09.10 Thursday
12:20 – 14:00 M. DeVos
14:30 – 16:00 M. DeVos

10.10 Friday
14:00 – 15:40 J. Makowsky

13.10 Monday
14:00 – 15:40 M. DeVos

16.10 Thursday
12:20 – 14:00 J. Makowsky
14:30 – 16:00 J. Makowsky

20.10 Monday
14:00 – 15:40 G. Kun

23.10 Thursday
12:20 – 14:00 M. Pinsker
14:00 – 15:30 G. Kun

03.11 Monday
14:00 – 15:40 M. Pinsker

06.11 Thursday
12:20 – 14:00 M. Pinsker
14:30 – 16:00 M. Pinsker

10.11 Monday
14:00 – 15:40 L. Zdeborová

11.11 Tuesday (in room S7, 2nd floor)
14:00 – 15:40 L. Zdeborová

20.11 Thursday
12:20 – 14:00 L. Zdeborová

The intended audience includes graduate students and postdocs in Mathematics or Computer Science. Students at other universities (domestic and abroad) are welcome. Financial assistance is possible: please write to andrew@iuuk.mff.cuni.cz

Students taking the KAM/ IÚUK course Vybrané Kapitoly z Kombinatoriky I (Selected Chapters in Combinatorics) may as an alternative to end-of-semester exams select at least two of the special lectures and write an exam in the form of a project based on material from these lectures. Complementary lectures will be given by Prof. Nešetřil and Dr Goodall, details of which will become available at the beginning of the Doc-Course. See **http://iuuk.mff.cuni.cz/events/doccourse2014/** for up-to-date information.

Structural Graph Theory

Doc-Course, October - December 2014
Charles University in Prague

Vybrané Kapitoly z Kombinatoriky I/ Selected Chapters in Combinatorics NDMI055

Guarantor: J. Nešetřil, A. Goodall Assistant: L. Vena Cros

http://iuuk.mff.cuni.cz/events/doccourse2014/

Prof. M. DeVos
Simon Fraser University, Vancouver

Prof. J. Makowsky
Technion - Israel Institute of Technology, Haifa

Dr G. Kun
ELTE, Budapest

Prof. M. Pinsker
Technische Universität Wien/ Université Diderot - Paris 7

Dr L. Zdeborová
CEA & CNRS, Saclay

Computer Science Inst. (IÚUK) & Dept. Applied Mathematics (KAM), Faculty of Mathematics and Physics (MFF), Charles University (UK), Malostranské nám. 25, Prague 1, Czech Republic