10th Open University Winter Combinatorics Meeting

Wednesday 28 January 2009

The talks will take place in room CMR11 on the Open University campus in Milton Keynes.

Timetable

10:00 - 10:25	Tea/Coffee (in M Block, Room Q229)
10:30 - 10:35	Welcome and introduction Jozef Širáň, Professor of Mathematics and opening speaker at the 1st OUWCM
10:40 - 11:20	Edita Mačajova, Comenius University, Bratislava *Colouring of cubic graphs by Steiner triple systems and Abelian groups*
11:25 - 12:25	Tim Gowers, University of Cambridge *Combinatorial theorems inside sparse random sets*
12:30 - 13:35	Lunch
13:40 - 14:20	Fedor Fomin, University of Bergen, Norway *Exact algorithms for NP hard problems*
14:25 - 15.05	Jan van den Heuvel, London School of Economics *Distance-two colouring of graphs*
15:10 - 15:25	Tea/Coffee (in M Block, Room Q229)
15:30 - 16:10	Gareth Jones, University of Southampton *Complete bipartite maps*
16:15 - 16:55	Peter Cameron, Queen Mary, University of London *Synchronization*

The meeting is financially supported by the British Combinatorial Committee.

Abstracts

Colouring of cubic graphs by Steiner triple systems and Abelian groups

Edita Mačajova, Comenius University, Bratislava

A cubic graph is *S-edge-colourable* for a Steiner triple system S if its edges can be coloured with points of S in such a way that the points assigned to the three edges sharing a vertex form a triple in S. A cubic graph is *A-edge-colourable* for an Abelian group A if its edges can be assigned elements of A in such a way that the resulting colouring is proper and the elements of A on the three edges meeting at a vertex sum to zero in A.

We survey old and new results on the edge-colourability of cubic graphs by Steiner triple systems and Abelian groups. In particular, we show that these colourings are closely related to several well-known conjectures, such as the Fulkerson conjecture and the cycle double cover conjecture.

Combinatorial theorems inside sparse random sets

Tim Gowers, University of Cambridge

An important recent trend in probabilistic combinatorics has been to find "sparse random versions" of well-known theorems. For example, Turan's theorem tells us that if G is a graph with edge density greater than $1 - 1/r$, then G contains a clique with $r + 1$ vertices. The sparse random version of Turan's theorem tells us that if U is a sparse random graph, then with high probability every subgraph G of U with density greater (by an arbitrarily small constant) than $1 - 1/r$ inside U, must contain a clique with $r + 1$ vertices. But how sparse is sparse? If U is too sparse then simple arguments show that such a statement is false. I shall discuss a very general method that appears to deal with all such problems and give best possible results up to a constant, which resolves many open problems. This is joint work with David Conlon.

Exact algorithms for NP hard problems

Fedor Fomin, University of Bergen, Norway

It is a common belief that exponential time algorithms are unavoidable when we want to find an exact solution of an NP hard problem. Well, every NP complete problem can be solved in exponential time in brute-force manner by trying all possible solutions. It appears that for many problems brute force can be avoided, and this is what the area of exact algorithms is about.

The design of such algorithms has a long history dating back to Held and Karp's paper on the travelling salesman problem in the early sixties. The last years have seen an emerging interest in constructing exact algorithms for combinatorial problems like colouring, max-cut, 3-SAT, minimum dominating set, treewidth, and maximum independent set. There are many interesting combinatorial problems around this area. In this talk we overview some recent results and techniques in the area of exact algorithms and conclude with several open problems.

Distance-two colouring of graphs

Jan van den Heuvel, London School of Economics

A *distance-two colouring* of a graph G is a colouring of the vertices of G in which vertices at distance one or two must get different colours. This is obviously the same as a normal (proper) vertex-colouring of the *square* G^2 of G, where G^2 is the graph with the same vertex set as G and with an edge between any two different vertices that have distance at most two in G. Finding the chromatic number of squares of graphs has been an area of intensive research, in particular for planar graphs.

In this talk I will discuss some recent results on the chromatic number of squares of planar graphs and related problems. In fact, most of our results will be true for the list chromatic version and for more general classes of graphs.

This talk is based on joint work with
Frédéric Havet (INRIA, Sophia-Antipolis), Colin McDiarmid (University of Oxford), and Bruce Reed (McGill University, Montreal and INRIA, Sophia-Antipolis): and with
Omid Amini (Max-Planck-Institut für Informatik, Saarbrücken) and Louis Esperet (LaBRI, Bordeaux).

Complete bipartite maps

Gareth Jones, University of Southampton

The regular embeddings of complete bipartite graphs $K_{n,n}$ in orientable surfaces are classified and enumerated, and their automorphism groups and combinatorial properties are determined. The method depends on earlier classifications in the cases where n is a prime power, obtained in collaboration with Shao-Fei Du, Jin Ho Kwak, Roman Nedela and Martin Škoviera, together with results of Itô, Hall, Huppert and Wielandt on factorizable groups and on finite solvable groups. The Erdös-Rényi random graph also makes an unexpected appearance in the proof.

Synchronization

Peter Cameron, Queen Mary, University of London

A reset word in a finite deterministic automaton is a word in the transitions which leaves the automaton in a fixed state no matter what state it was in before; in other words, a constant function in the transformation semigroup generated by the transitions. Recently there has been some interest in permutation groups which have the property that, if any any transformation which is not a permutation is adjoined to the group, the semigroup they generate contains a reset word; such permutation groups are called synchronizing. The talk will consider this and stronger properties of permutation groups lying between primitivity and 2-transitivity (some of which can be used to bound the length of a reset word), and connections with graph homomorphisms and cores.