Wednesday May 16th, Queen Mary

1030 MLT **Anthony Hilton**

Queen Mary, University of London

Degree bounded factorizations of graphs

For $d \geq 1$, $s \geq 0$ a $(d, d+s)$-*graph* is a graph whose degrees all lie in the interval $\{d, d+1, \ldots, d+s\}$. For $r \geq 1$, $a \geq 0$ an $(r, r+a)$-*factor* of a graph G is a spanning $(r, r+a)$-subgraph of G. An $(r, r+a)$-*factorization* of a graph G is a decomposition of G into edge-disjoint $(r, r+a)$-factors.

We discuss a number of results about $(r, r+a)$-factorizations of $(d, d+s)$-graphs. The emphasis will be on the contrast between the good results known for simple graphs and pseudographs (i.e. multigraphs with loops permitted), and the much less satisfactory results known for multigraphs (without loops).

As an example of the results, for $t \geq 1$ let $\pi(r, s, a, t)$ be the least integer such that, if $d \geq \pi(r, s, a, t)$ then each $(d, d+s)$-pseudograph has an $(r, r+a)$-factorization into x $(r, r+a)$-factors for at least t different values of x. Then if r and a are even,

$$\pi(r, s, a, t) = r \left\lceil \frac{tr + s - 1}{a} \right\rceil + (t-1)r\,.$$

1130, Room 103 **David Conlon**

University of Cambridge

Some new results in Ramsey Theory

Ramsey's Theorem states that, given two natural numbers k and l, there exists a number n such that if the edges of a complete graph on n vertices are two-coloured, in red and blue, then the graph must contain either a red K_k or a blue K_l. The smallest such n is referred to as the Ramsey number $r(k, l)$.

We will discuss some results related to this theorem, amongst which are a new general upper bound for Ramsey's theorem itself, a new upper bound for its bipartite analogue, and a new lower bound for the multiplicity version of the question (by which I mean the question of determining, given a fixed size k, how many monochromatic cliques of size k one is guaranteed to have in any two-colouring of K_n, for n large).

1130, MLT **Robin Wilson**

Open University

Euler's science of combinatorics

In 1973 Norman Biggs asked for volunteers to help with a book on the history of graph theory which he was thinking of writing, and the result, three years later, was 'Graph Theory: 1736-1936' which we wrote jointly with Keith Lloyd. Working on this book gave rise to an interest in the history of mathematics which has never left me. In this talk I shall outline some developments in the history of graph theory and combinatorics since it appeared, with particular reference to the works and legacy of Leonhard Euler who is featured in the book and whose 300th anniversary took place this year.

1215, Room 103 **Jackie Daykin**

Royal Holloway, University of London

String factorization algorithmics

A string is a finite sequence of symbols over an arbitrary alphabet, and a factorization is a partitioning of a string. We say a set W of strings is a circ-UMFF if every string has a unique maximal factorization over W. The classic circ-UMFF is the set of Lyndon words defined using lexicographic ordering.

In this presentation optimal Lyndon factorization algorithms will be outlined for both the sequential and CRCW PRAM parallel models of computing. While the sequential algorithm can be implemented with a simple array, the parallel algorithm requires a suffix tree data structure. We further describe characteristic combinatorial properties of all circ-UMFFs and the construction of such a set. We illustrate with additional examples of circ-UMFFs where each is derived from a method for totally ordering sets. These include the V-word circ-UMFF derived from the V-order method for totally ordering strings over arbitrary alphabets, and a collection of 32 circ-UMFFs defined from methods for totally ordering binary strings. It will then be shown that the underlying tree structure of the parallel Lyndon factorization algorithm can be applied to the parallel decomposition of a string over any given circ-UMFF. Commencing with an algorithm for sequential V-word factorization we describe our progress towards a generic approach for string factoring algorithms.

This talk aims to motivate the area of string factorization, explain the combinatorial language properties of circ-UMFFs, and describe the design and analysis of corresponding factoring algorithms. The work is mainly joint with D. Daykin.

1215, MLT **Tony Gardiner**

University of Birmingham

Combinatorics for the common man

The characteristic clarity of Norman's writing over the years has made combinatorial ideas accessible to tens of thousands of mathematics and computer science students. The talk will use specific examples to explore the question of how combinatorial ideas might (and whether they should) be introduced earlier than has traditionally been the case in England.

1400, MLT **Béla Bollobás**

University of Cambridge & University of Memphis

Problems, conjectures and results on the two-dimensional square lattice

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1445, MLT **Douglas Woodall**

University of Nottingham

Recent results on graph colourings

A more precise title for this talk would be 'Lower bounds for the average degree of a graph critical with respect to edge or total colouring or choosability.' There are two parts.

(1) A graph is *edge-Δ-critical* if it has maximum degree Δ and the deletion of any edge reduces its edge chromatic number χ' from $\Delta + 1$ to Δ. It has long been conjectured that every edge-Δ-critical graph has average degree greater than $\Delta - 1$. The best lower bound on the average degree for large Δ has recently been improved from $\frac{1}{2}(\Delta + \sqrt{2\Delta - 1})$ to $\frac{2}{3}(\Delta + 2)$.

(2) There are several classes of graphs G for which it is conjectured that the choosability or list chromatic number ch(G) is equal to the chromatic number $\chi(G)$. I will mention some of these, and discuss an analogue of problem (1) for edge-choosability and total choosability.

1545, MLT

Svante Janson

University of Uppsala

Two sorting problems and the maximum number of runs in a randomly evolving sequence

We study the space requirements of a sorting algorithm where only items that at the end will be adjacent are kept together. This is equivalent to the following combinatorial problem: Consider a string of fixed length n that starts as a string of 0's, and then evolves by changing each 0 to 1, with the changes done in random order. What is the maximal number of runs of 1's?

We give asymptotic results for the distribution and mean. It turns out that, as in many problems involving a maximum, the maximum is asymptotically normal, with fluctuations of order $n^{1/2}$, and to the first order well approximated by the number of runs at the instance when the expectation is maximized, in this case when half the elements have changed to 1; there is also a second order term of order $n^{1/3}$.

We also treat some variations, including a sock sorting problem.

1630, MLT

Colin McDiarmid

University of Oxford

Random graphs on surfaces

There have been dramatic successes recently with the two related problems of counting labelled planar graphs, and finding typical properties of random labelled planar graphs. We start the process here of extending such investigations to graphs embeddable on any fixed surface S. In particular we see that the labelled graphs embeddable on S have the same growth constant as for planar graphs, and the same holds for unlabelled graphs. Also, if we pick a graph uniformly at random from the graphs embeddable on S which have vertex set $\{1, \ldots, n\}$, then with probability tending to 1 as $n \to \infty$, this random graph consists of one giant component together with at most a few nodes in small planar components.

Thursday May 17th, LSE

All talks take place in the New Theatre, E171

1000 **Dominic Welsh**

University of Oxford

Counting problems in minor closed classes of graphs

If $\mathcal{H}$ is a finite collection of graphs, $\mathbf{Ex}(\mathcal{H})$ denotes the class of graphs G such that G has no member of $\mathcal{H}$ as a *minor*.

The classical example is when $\mathcal{H} = \{K_5, K_{3,3}\}$ so that $\mathbf{Ex}(\mathcal{H})$ is the set of all planar graphs.

The problem of counting the labelled graphs in a minor closed family is solved only in a few very special cases, notably the recent work of Gimené z and Noy (2005) which gives precise results in the planar case.

Here we present some recent new results for the case where $\mathcal{H}$ is a general finite family.

[This is joint work with Olivier Bernardi and Marc Noy.]

1105 **John Shawe-Taylor**

University College London

Graph Complexity for Structure and Learning

The talk will consider ways of bounding the complexity of a graph as measured by the number of partitions satisfying certain properties. The approach adopted uses Vapnik Chervonenkis dimension techniques. An example of such a bound was given by Kleinberg et al (2004) with an application to network failure detection. We describe a new bound in the same vein that depends on the eigenvalues of the graph Laplacian. We show an application of the result to transductive learning of a graph labelling from examples.

1150 **Derek Smith**

University of Glamorgan

From distance-transitive graphs to spectrum efficiency

The work of Norman Biggs in the late 1960s focused on distance-transitive graphs and also on colouring problems in graphs. In the 1970s he applied some of the ideas arising in the theory of distance-transitive graphs to coding theory. In the 1990s he developed an interest in the application of the algorithms and theory of graph colouring to radio frequency assignment.

In this talk some of the early work will be outlined. It will also be shown how it has inspired more recent work in radio spectrum efficiency. This work includes:

1) Radio frequency assignment treated as a generalized graph colouring problem;

2) Other approaches to radio frequency assignment when multiple interference must be considered;

3) The construction of constant weight codes and their assignment in networks using frequency hopping;

4) The construction of codes for code-division multiple-access radio systems and the potential for code assignment;

5) The relevance of partitions of certain codes into Hadamard matrices to the security of certain code-division multiple-access radio systems.

The talk will include an indication of the current state of the art in frequency assignment. However the main aim of the talk is to show how interesting combinatorial problems arise in work on spectrum efficiency.

1400 **Chris Godsil**

University of Waterloo, Canada

Quantum Physics and Algebraic Graph Theory

The possibility of a quantum computer has led to much new work in theoretical physics. Naturally enough, this works has raised many new mathematical problems. What is perhaps surprising is that it has led to interesting problems in algebraic graph theory. I will discuss some of these problems, and the progress we have made on them.

1520 **Peter Rowlinson**

University of Stirling

Star complements in regular graphs

Let G be a finite simple graph with μ as an eigenvalue of multiplicity k. (Thus the corresponding eigenspace of a $(0,1)$-adjacency matrix of G has dimension k.) We can always find a vertex v of G such that $G - v$ has μ as an eigenvalue of multiplicity $k-1$. Accordingly there exists a subset X of the vertex set $V(G)$ such that $|X| = k$ and $G - X$ does not have μ as an eigenvalue. Such a set is called a *star set* for μ in G, and the graph $G - X$ is called a *star complement* for μ in G.

The talk describes how star complements can be used (i) to determine sharp upper bounds for k (when μ is not -1 or 0) in arbitrary graphs and in regular graphs, (ii) to investigate extremal strongly regular graphs, (iii) to characterize the Hoffman-Singleton graph among regular graphs

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1610 **Norman Biggs**

London School of Economics

The Naming of Parts

Special presentation.

The talk will be followed, at 5:00 or shortly thereafter, by a reception in the Senior Common Room, to which all are warmly invited.