EXCILL: Extremal Combinatorics at Illinois

Department of Mathematics, University of Illinois at Urbana-Champaign

Schedule of Talks

Saturday, November 18, 2006

9:45-10:00	**Sheldon Katz**, Chair of UIUC Math Dept, Welcoming Remarks
10:00–10:50	**Robin Thomas**, Coloring graphs on surfaces with all faces even, pg 3
11:00–11:30	coffee
11:30–11:55	**Penny Haxell**, Independent dominating sets and Hamilton cycles, pg 3
12:00–12:25	**Dhruv Mubayi**, Erdős-Ko-Rado for three sets, pg 3
12:30–2:00	lunch
2:00–2:50	**Jeff Kahn**, Many Hamiltonian cycles, pg 3
3:00–3:25	**Paul Balister**, Interference Percolation, pg 4
3:30–3:55	**Peter Winkler**, Random Walk with Planted Coins, pg 4
4:00–4:30	coffee
4:30–4:55	**Assaf Naor**, Ramsey theorems on metric spaces, pg 4
5:00–5:25	**Jerrold R. Griggs**, Problems in the Boolean Lattice, pg 4
5:30–5:55	**Guantao Chen**, Linkages with Modular Constraint, pg 5
6:15–	dinner—pizza in Altgeld Hall

Sunday, November 19, 2006

9:30–10:20	**Daniel Kleitman**, Some Problems on Reducing Planar Graphs to Forests, pg 5
10:30-11:00	coffee
11:00–11:25	**Felix Lazebnik**, On monomial graphs of girth eight, pg 6
11:30–11:55	**János Pach**, Coloring Geometric Hypergraphs, pg 6
12:00–12:25	**József Solymosi**, Partition Regular Sets of Matrices, pg 6
12:30–2:00	lunch
2:00–2:50	**Béla Bollobás**, The Angel and the Devil—The Final Confrontation, pg 6
3:00–3:25	**András Gyárfás**, The largest monochromatic double star in edge-colored complete graphs, pg 7
3:30–3:55	**Oleg Pikhurko**, Minimum H-Decompositions of Graphs, pg 7
4:00–4:30	coffee
4:30–4:55	**Benny Sudakov**, Induced subgraphs of Ramsey graphs with many distinct degrees, pg 7
5:00–5:25	**Radoš Radoičić**, Turán-type problems for planar intersection graphs, pg 7
5:30–5:55	**Tao Jiang**, Anti-Ramsey and constrained Ramsey numbers, pg 8
6:45–	dinner at Chinatown Buffet

Monday, November 20, 2006

9:30–10:20	**Miki Simonovits**, The Typical Structure of Graphs without Given Excluded Subgraphs, pg 8
10:30-11:00	coffee
11:00–11:25	**Vladimir Nikiforov**, Improving some "good" Ramsey results, pg 8
11:30–11:55	**Gábor Sárközy**, New coloring applications of the Regularity Lemma, pg 8
12:00–12:25	**Richard Schelp**, Cycles and Stability, pg 9
12:30–2:00	lunch
2:00–2:25	**William T. Trotter**, A Fresh Look at Some Old Extremal Problems, pg 9
3:00–3:25	**Attila Sali**, Codes that attain minimum distance in all possible directions, pg 9
3:30–3:55	**Mike Jacobson**, Graphs that have Hamiltonian Cycles Avoiding Sets of Edges, pg 10
4:00–4:25	**Hal Kierstead**, On-line Ramsey Theory, pg 10
4:30–4:55	**Neil Robertson**, On the clique minor numbers of a graph and its complement, pg 10

Alphabetical Index of Presenters

Abstracts

Robin Thomas, Georgia Institute of Technology, Sat 10:00–10:50
Coloring graphs on surfaces with all faces even

Let G be a graph drawn (without crossings) on a fixed surface such that every face is bounded by a walk of even length, and let k be an integer. Can G be properly k-colored? This is easy if $k \neq 3$. We settle the case $k = 3$ by proving a coloring extension theorem that implies a polynomial-time algorithm. The notion of "winding number" plays an important role. We will also survey related results about coloring graphs on surfaces.

This is joint work with Dan Kral.

Penny Haxell, University of Waterloo, Sat 11:30–11:55
Independent dominating sets and Hamilton cycles

A graph is said to be *uniquely Hamiltonian* if it contains exactly one Hamilton cycle. We show that there are no r-regular uniquely Hamiltonian graphs for any $r > 22$. We use the approach of Thomassen, who proved that for any graph G with a Hamilton cycle C, if G contains a vertex subset S that is independent in C and dominating in $G - C$, then G has a Hamilton cycle different from C.

This talk represents joint work with B. Seamone and J. Verstraete.

Dhruv Mubayi, University of Illinois at Chicago, Sat 12:00–12:25
Erdős-Ko-Rado for three sets

I will present a proof of the following 1983 conjecture of Frankl and Furedi which generalizes the Erdos-Ko-Rado theorem: Suppose that $n > 3k/2$ and F is a family of k-element subsets of an n-element set of size more than $\binom{n-1}{k-1}$. Then F contains three sets whose intersection is empty and union has size at most $2k$. Some further generalizations will also be presented.

Jeff Kahn, Rutgers University, Sat 2:00–2:50
Many Hamiltonian cycles

We'll begin with the following theorem, which proves a conjecture of Sárközy, Selkow and Szemerédi, and try to use it as an excuse to talk about other things (possibly including Brégman's Theorem, entropy, the "incremental random method," statistical physics...).

Theorem. *Any n-vertex Dirac graph (i.e. graph of minimum degree at least $n/2$) contains at least $(2 - o(1))^{-n} n!$ Hamiltonian cycles.*

Joint with Bill Cuckler.

Paul Balister, University of Memphis, Sat 3:00–3:25
Interference Percolation

Suppose we have an infinite communication network consisting of transceivers (vertices) and communication links (edges) forming a graph G. Suppose at some time each transceiver is active independently with probability p. We suppose that a message can be relayed through active transceivers, but with the restriction that if a transceiver has more than k active neighbors, then interference between the signals means that this transceiver cannot effectively relay a message. We wish to know whether a message can be propagated effectively, i.e., whether the number of sites that can communicate with some fixed origin is infinite with positive probability.

We show that if $k = 3$, $\delta \geq 6$, and Δ/δ is not too large then almost surely there is no long range communication. Moreover, this result is essentially best possible since there are examples of graphs giving long range communication with any single one of these three conditions removed. In particular, we show that there is long range communication in the lattice Z^d for large d and $k \geq 4$, and in the Gilbert model in R^2 for large k and sufficiently large communication range.

Joint work with Béla Bollobás.

Peter Winkler, Dartmouth College, Sat 3:30–3:55
Random Walk with Planted Coins

To reach n or $-n$ from 0 via simple random walk on the number line, you need about n^2 coin tosses. But suppose the coins must be planted in advance in space-time; how many coins are required then? The solution has a slick proof and a surprising application to a 150-year-old physics puzzle.

Joint work with M. Paterson, Y. Peres, M. Thorup and U. Zwick.

Assaf Naor, Microsoft Research, Sat 4:30–4:55
Ramsey theorems on metric spaces

In this talk we will survey the history and known results on metric Ramsey problems. An example of such a problem is: Given $\alpha > 1$ and $n \in \mathbb{N}$, what is the largest integer m such that any n-point metric space has a subset of size m which embeds into Hilbert space with distortion at most α? We will also discuss the motivation for this problem from Banach space theory (the non-linear Dvoretzky theorem) and theoretical computer science (online algorithms and proximity data structures).

Joint work with Manor Mendel.

Jerrold R. Griggs, University of South Carolina, Sat 5:00–5:25
Problems in the Boolean Lattice

We shall present recent and continuing work on problems concerning the Boolean lattice B_n of all subsets of an n-element set X. Especially, we shall discuss a joint project with Gyula O. H. Katona concerning the "YBLM Inequality". Better known as LYM, it is a linear inequality satisfied by the parameters f_i of any antichain F of subsets of X, where f_i denotes the number of subsets in F of size i. However, this necessary condition for the profiles $(f_0, ..., f_n)$ of antichains in B_n is far from sufficient, and we seek inequalities satisfied by profiles of antichains that eliminate some of the profiles satisfying YBLM for which no antichain exists. We build on earlier work of Christian Bey. Our project also relates to the Kruskal-Katona-Lovasz shadow function.

Guantao Chen, Georgia State University, Sat 5:30–5:55
Linkages with Modular Constraint

A graph G is *k-linked* if G has at least $2k$ vertices, and for every sequence $x_1, x_2, \ldots, x_k; y_1, y_2, \ldots, y_k$ of distinct vertices, G contains k vertex-disjoint paths $P_1, P_2, \ldots, P_k$ such that P_i joins x_i and y_i for $i = 1, 2, \ldots, k$. Moreover, the above defined k-linked graph G is *k-linked modulo $(m_1, m_2, \ldots, m_k)$* if, in addition, for any k-tuple $d_1, d_2, \ldots, d_k$ of natural numbers, the paths $P_1, P_2, \ldots, P_k$ can be chosen such that P_i has length d_i modulo m_i for $i = 1, 2, \ldots, k$. Thomassen showed that there exists a function $f(m_1, m_2, \ldots, m_k)$ such that every $f(m_1, m_2, \ldots, m_k)$-connected graph is k-linked modulo $(m_1, m_2, \ldots, m_k)$ provided all m_i are odd. For even moduli, he showed in another article that there exists a natural number $g(2, 2, \cdots, 2)$ such that every $g(2, 2, \cdots, 2)$-connected graph is k-linked modulo $(2, 2, \cdots, 2)$ if deleting any $4k-3$ vertices leaves a nonbipartite graph.

In this talk, we present linear upper bounds for $f(m_1, m_2, \ldots, m_k)$ and $g(m_1, m_2, \ldots, m_k)$ in terms of $m_1, m_2, \ldots, m_k$, respectively. More specifically, we prove the following two results: (i) For any k-tuple $(m_1, m_2, \ldots, m_k)$ of odd positive integers, every $\max\{14(m_1 + m_2 + \cdots + m_k) - 4k, 6(m_1 + m_2 + \cdots + m_k) - 4k + 36\}$-connected graph is k-linked modulo $(m_1, m_2, \ldots, m_k)$. (ii) Let $1 \le \ell \le k$ and let $(m_1, m_2, \ldots, m_k)$ be a k-tuple of positive integers such that m_i is odd for each i with $\ell + 1 \le i \le k$. If G is $45(m_1 + m_2 + \cdots + m_k)$-connected, then either G has a vertex set X of order at most $2k + 2\ell - 3 + \delta(m_1, \ldots, m_\ell)$ such that $G - X$ is bipartite or G is k-linked modulo $(2m_1, 2m_2, \ldots, 2m_\ell, m_{\ell+1}, \ldots, m_k)$, where

$$\delta(m_1, \ldots, m_\ell) = \begin{cases} 0 & \text{if } \min\{m_1, \ldots, m_\ell\} = 1, \text{ and} \\ 1 & \text{if } \min\{m_1, \ldots, m_\ell\} \ge 2. \end{cases}$$

Our results generalize several known results on k-parity-linked graphs. Joint work with Shuhong Gao and Zhiquan Hu.

Daniel Kleitman, Massachusetts Institute of Technology, Sun 9:30–10:20
Some Problems on Reducing Planar Graphs to Forests

We discuss problems of the form: if G is a planar graph of girth k and we wish to partition its edges into those forming a forest F and others forming a graph Q, how small can the maximum vertex degree in Q be? For most values of k such questions are easily resolved, but there are a few that seem to be quite difficult. We give some new answers and describe some open problems.

Felix Lazebnik, University of Delaware, Sun 11:00–11:25
On monomial graphs of girth eight

Let e be a positive integer, p be a odd prime, $q = p^e$, and $\mathbb{F}_q$ be the finite field of q elements. Let $f_2, f_3 \in \mathbb{F}_q[x, y]$. The graph $G = G_q(f_2, f_3)$ is a bipartite graph with vertex partitions $P = \mathbb{F}_q^3$ and $L = \mathbb{F}_q^3$, and edges defined as follows: a vertex $(p) = (p_1, p_2, p_3) \in P$ is adjacent to a vertex $[l] = [l_1, l_2, l_3]$ if and only if

$$p_2 + l_2 = f_2(p_1, l_1) \quad \text{and} \quad p_3 + l_3 = f_3(p_1, l_1).$$

Motivated by some questions in finite geometry and extremal graph theory, we ask when G has no cycle of less than eight, i.e., has girth at least eight. When f_2 and f_3 are monomials, we call G a monomial graph. We show that for $p \geq 5$, and $e = 2^a 3^b$, a monomial graph of girth at least eight has to be isomorphic to graph $G_q(xy, xy^2)$, which is an induced subgraph of the classical generalized quadrangle $W(q)$. For all other e, we show that a monomial graph is isomorphic to a graph $G_q(xy, x^k y^{2k})$, with $1 \leq k \leq (q-1)/2$ and k satisfying several other strong conditions. These conditions imply that $k = 1$ for $q \leq 10^{10}$. In particular, for a given positive integer k, graph $G_q(xy, x^k y^{2k})$ can be of girth eight only for finitely many odd characteristics p. The approach relies heavily on the theory of permutation polynomials.

This is a joint work with V. Dmytrenko and J. Williford.

János Pach, Courant Institute, New York University, Sun 11:30–11:55
Coloring Geometric Hypergraphs

The following two strongly related coloring problems for geometrically defined hypergraphs arose in connection with frequency allocation in cellular networks.

1. What is the smallest number of colors needed to color the vertices of a hypergraph so that each hyperedge H has a vertex whose color is not shared by any other element of H?
2. Suppose that every hyperedge of a hypergraph is sufficiently large. Is it possible to color the vertices with k colors so that every hyperedge contains at least one point of each color?

We give some partial answers to these questions in various settings and ask many open questions.

József Solymosi, University of British Columbia, Sun 12:00–12:25
Partition Regular Sets of Matrices

We say that a matrix A is image-partition-regular if, whenever N is coloured by finitely many colours, there is a vector x such that all entries of Ax have the same colour. Image-partition-regular matrices were characterized by Hindman, Leader, and Strauss. In this talk we consider the following generalization of the problem. A set of $n \times m$ matrices $A_1, ..., A_k$ is image-partition-regular if whenever N^n is coloured by finitely many colours, there is a vector x such that all vectors $A_i x$ have the same colour. We will show examples for some image-partition-regular sets of matrices. Our main tool is the hypergraph removal lemma.

Béla Bollobás, Cambridge University and University of Memphis, Sun 2:00–2:50
The Angel and the Devil—The Final Confrontation

In this talk, which will be understandable by undergraduates, we shall sketch several recent solutions of Conway's 'The Angel and the Devil' game in two dimensions.

András Gyárfás, Hungarian Academy of Sciences and Univ. of Memphis, Sun 3:00–3:25
The largest monochromatic double star in edge-colored complete graphs

It is known that for $r > 1$, in every r-coloring of the edges of K_n, there is a monochromatic component of size at least $\frac{n}{r-1}$ (this is best possible when $r-1$ is a power of prime and n is divisible by $(r-1)^2$). A very short proof is obtained recently by Liu, Morris and Prince. I show how to apply their method to prove a stronger result for $r > 2$: in every r-coloring of the edges of K_n there is a monochromatic double star of size at least $\frac{n}{r-1}$. This is a joint result with G. N. Sárközy.

Oleg Pikhurko, Carnegie-Mellon University, Sun 3:30–3:55
Minimum H-Decompositions of Graphs

An H-*decomposition* of a graph G is a partition of $E(G)$ into copies of H and single edges. Let $\phi_H(G)$ be the minimum number of parts in a such decomposition. Clearly, $\phi_H(G) = e(G) - e(H)p_H(G) + p_H(G)$, where $p_H(G)$ is the maximum number of edge-disjoint copies of H in G.

Here we study $\phi_H(n) = \max_{\phi_H(G):v(G)=n}$, the smallest ϕ such that any graph of order n admit an H-decomposition with at most ϕ parts. We prove that $\phi_H(n) = (\frac{r-2}{2(r-1)} + o(1))n^2$ if $r = \chi(H) \geq 3$ and compute $\phi_H(n)$ with an additive error $O(1)$ if H is bipartite.

Joint work with Teresa Sousa.

Benny Sudakov, Princeton University, Sun 4:30–4:55
Induced subgraphs of Ramsey graphs with many distinct degrees

An induced subgraph is called homogeneous if it is either a clique or an independent set. Let $hom(G)$ denote the size of the largest homogeneous subgraph of a graph G. In this short paper we study properties of graphs on n vertices with $hom(G) < C \log n$ for some constant C. We show that every such graph contains an induced subgraph of order αn in which $\beta\sqrt{n}$ vertices have different degrees, where α and β depend only on C. This proves a conjecture of Erdős, Faudree and Sós.

Joint work with Boris Bukh.

Radoš Radoičić, Rutgers University, Sun 5:00–5:25
Turán-type problems for planar intersection graphs

Pach and Sharir (2006) recently initiated the study of extremal questions for intersection graphs of convex sets in the plane. Let $\mathcal{C}$ be a family of n convex sets in the plane, whose intersection graph $\Gamma(\mathcal{C})$ has no complete bipartite subgraph with k vertices in each of its classes. They proved that $\Gamma(\mathcal{C})$ has at most $O(n \log n)$ edges, where the constant with the O-notation depends on k. They conjectured that this bound can be improved to $O(n)$ for every k, which they established only for $k = 2$. We consider the same question for bipartite graphs other than complete and establish their conjecture in the cases when the forbidden subgraph is C_6, C_8, $K_{2,3}$, or $K_{2,4}$. Our proof uses a discharging method of Ackerman, who used it to prove an $O(n)$ upper bound on the number of edges in topological graphs on n vertices and without 4 pairwise crossing edges.

This is a joint work with J. Pach and G. Tóth.

Tao Jiang, University of Miami, Ohio, Sun 5:30–5:55
Anti-Ramsey and constrained Ramsey numbers

We study various color patterns in edge-colorings of complete graphs. Given an edge-colored complete graph, a subgraph H is *monochromatic* if all of its edges have the same color and H is *rainbow* if all of its edges have different colors.

The classical Ramsey problem is concerned with monochromatic subgraphs. Here we study both monochromatic and rainbow subgraphs. Fixing n and H, let $AR(n, H)$ denote the maximum number of colors in any edge-coloring of K_n that does not contain a rainbow copy of H. We call this the *Anti-Ramsey number* of H. This parameter is closely related to Turan numbers.

Fixing two graphs G and H, let $R(G, H)$ denote the minimum n such that every edge-coloring of K_n must contain either a monochromatic copy of G or a rainbow copy of H. We call $R(G, H)$ the *constrained Ramsey number* of G and H.

We survey some recent results on Anti-Ramsey numbers and Constrained Ramsey numbers and we pose some problems.

Miki Simonovits, Rényi Math Institute, Mon 9:30–10:20
The Typical Structure of Graphs without Given Excluded Subgraphs

Let $\mathcal{L}$ be a finite family of graphs. We describe the typical structure of $\mathcal{L}$-free graphs, improving our earlier results on the Erdős-Frankl-Rödl theorem, by proving our conjecture from our earlier paper. Let

$$p = p(\mathcal{L}) = \min_{L \in \mathcal{L}} \chi(L) - 1.$$

We shall prove that the structure of almost all $\mathcal{L}$-free graphs are very similar to the Turán graph $T_{n,p}$, where "similarity" is measured in terms of graph theoretical parameters of $\mathcal{L}$.

Joint work with J. Balogh and B. Bollobás.

Vladimir Nikiforov, University of Memphis, Mon 11:00–11:25
Improving some "good" Ramsey results

In a seminal paper from 1983, Burr and Erdős started the systematic study of "p-good" Ramsey results, raising, as usual, a number of unsolved problems. In a recent joint paper, C.C. Rousseau and the speaker developed a new approach to such problems using a mix of the regularity lemma, embedding of sparse graphs, and Turán-type stability. This approach gives exact Ramsey numbers for wide classes of graphs, solving all but one of the Burr-Erdős problems.

Gábor Sárközy, Worcester Polytechnic Institute, Mon 11:30–11:55
New coloring applications of the Regularity Lemma

We present some new coloring applications of the Regularity Lemma. Among other results, by proving an old conjecture of Faudree and Schelp, we determine the exact three color Ramsey numbers for paths. More precisely we show that $R(P_n, P_n, P_n)$ is $2n - 1$ if n is odd, and $2n - 2$ if n is even.

This is joint work with András Gyárfás, Miklós Ruszinkó and Endre Szemerédi.

Richard Schelp, University of Memphis, Mon 12:00–12:25
Cycles and Stability

We prove a number of Turán and Ramsey type stability results for cycles, in particular, the following one:

Let $n \geq 4$, $0 < \beta \leq 1/2 - 1/2n$, and the edges of $K_{\lfloor (2-\beta)n \rfloor}$ be 2-colored so that no mononchromatic C_n exists. Then, for some $q \in ((1-\beta)n - 1, n)$, we may drop a vertex v so that in $K_{\lfloor (2-\beta)n \rfloor} - v$ one of the colors induces $K_{q, \lfloor (2-\beta)n \rfloor - q - 1}$, while the other one induces $K_q \cup K_{\lfloor (2-\beta)n \rfloor - q - 1}$.

We also derive the following Ramsey-type result.

If n is sufficiently large and G is a graph of order $2n-1$, with minimum degree $\delta(G) \geq \left(2 - 10^{-6}\right) n$, then for every 2-coloring of $E(G)$ one of the colors contains cycles C_t for all $t \in [3, n]$.

Joint work with V. Nikiforov.

William T. Trotter, Georgia Institute of Technology, Mon 2:00–2:25
A Fresh Look at Some Old Extremal Problems

More than 50 years ago, Hiraguchi proved for $n > 1$, the maximum dimension of a poset on $2n+1$ points is n. The standard example $S(n)$ consisting of the 1-element and $n-1$-element subsets of an n-element set ordered by inclusion shows that this inequality is best possible. For $n > 2$, the inequality is tight only when the poset contains $S(n)$, even though no entirely satisfactory proof of this fact has ever been written down. Regardless, the inequality leads naturally to the "Removable Pair Conjecture": Every poset with at least 3 points contains a pair whose removal decreases the dimension by at most 1. The Removable Pair Conjecture holds for the class of interval orders, and for trivial reasons, it holds for the class of posets of dimension at most 3. Here we investigate two classes of posets which in some sense are not much bigger than the union of these two classes. These classes were defined by Farhad Shahroki in conjunction with geometric questions in computer science and involved partial orders determined by families of line segments in the plane.

Attila Sali, Hungarian Academy of Sciences, Mon 3:00–3:25
Codes that attain minimum distance in all possible directions

Let $\mathcal{K}$ be the system of minimal keys in a relational database scheme R with respect to some collection of functional dependencies Σ. Then $\mathcal{K}$ is a Sperner system, or antichain, that is for $K_1 \neq K_2 \in \mathcal{K}$ $K_1 \not\subset K_2$ holds. Armstrong (and independently Demetrovics) proved that for each nonempty Sperner system of attribute sets there exists an instance of the scheme such that if the complete set of functional dependencies are considered that hold in that instance, then eaxactly the given Sperner system is the collection of minimal key sets. However, the constructions use unbounded domains for each attribute.

In the study of key systems in higher-order datamodels with counter attributes the case of bounded domains come up naturally. In the present paper we investigate the following problem. Assume that a relational scheme of n attributes is given, where each attribute's domain is of q elements. Furthermore, suppose that the minimal key sets are exactly all the k-element subsets of the set of attributes. Let $f(q,k)$ be the maximum n such that an Armstrong instance with the above properties exists. Considering the records or rows of the Armstrong instance as codewords of length n, the key property means that no two codewords can agree on k or more coordinates, that is the minimum distance is at least $n-k+1$. The minimal key property tells us that for any $k-1$-set of coordinates there are two codewords that agree exactly there. We give lower and upper bounds for $f(q,k)$. In particular, we show that $f(q,k)$ is bounded by linear functions of k and q, and determine the exact values for special k and q.

Mike Jacobson, University of Colorado, Denver, Mon 3:30–3:55
Graphs that have Hamiltonian Cycles Avoiding Sets of Edges

There has been a considerable collection of research providing sufficient conditions on a graph to assure that it contains a Hamiltonian cycle containing some set of edges and/or paths. This has been further extended to the concept of "visiting" these edges and paths in a chosen order. In this talk we will survey some of results and questions.

Then we propose the problem of finding conditions on graphs that imply that there exists a (hamiltonian) path and/or cycle that avoids a collection of edges. Preliminary results will be given and numerous problems presented.

Hal Kierstead, Arizona State University, Mon 4:00–4:25
On-line Ramsey Theory

Let c, s, t be positive integers. The (c, s, t)-*Ramsey game* is played by Builder and Painter. Play begins with an s-uniform hypergraph $G_0 = (V, E_0)$, where $E_0 = \emptyset$ and V is determined by Builder. On the ith round Builder constructs a new edge e_i (distinct from previous edges) and sets $G_i = (V, E_i)$, where $E_i = E_{i-1} \cup\ e_i$. Painter responds by coloring e_i with one of c colors. Builder wins if Painter eventually creates a monochromatic copy of K_s^t, the complete s-uniform hypergraph on t vertices; otherwise Painter wins when she has colored all possible edges.

We extend the definition of coloring number to hypergraphs so that $\chi(G) \leq \mathrm{col}(G)$ for any hypergraph G and then show that Builder can win (c, s, t)-Ramsey game while building a hypergraph with coloring number at most $\mathrm{col}(K_s^t)$.

Neil Robertson, Ohio State University, Mon 4:30–4:55
On the clique minor numbers of a graph and its complement

This talk will describe a theorem in Eliade Micu's dissertation "Graph minors and Hadwiger's conjecture". Let G be a simple graph on n vertices and denote the (edge-set) complement of G by G'. He proved that in general large graphs G (on at least 80 vertices, say) have $w*(G)w*(G') \geq n$, where $w*(G)$ is the clique-minor number of G. This follows from a more general result and has some consequences relative to Hadwiger's conjecture.