Combinatorics and Graph Theory
Abstracts

Saturday 3:15 – 5:15 (Graphs and Matroids)
Joan P. Hutchinson, Macalester College
Jo Ellis-Monaghan, St. Michael's College
Brigitte Servatius, WPI
Jenny McNulty, The University of Montana

Sunday 8:30 – 10:30
Jennifer Quinn, University of Washington, Tacoma
Pallavi Jayawant, Bates College
Marge Bayer, University of Kansas
Susanna Fishel, Arizona State University

Saturday (3:15-5:15) – Graphs and Matroids

Some problems on list-coloring planar graphs
Joan P. Hutchinson, Macalester College

A graph G is said to be L-list-colorable when each vertex v is assigned a list L(v) of colors and G can be properly colored so that each v receives a color from L(v). Typically the lists L may vary from vertex to vertex. A graph is said to be k-list-colorable when it can be L-list-colored whenever every list L(v) contains at least k colors. A celebrated theorem of C. Thomassen proves that every planar graph can be 5-list-colored. An unresolved question of M.O. Albertson asks whether there is a distance d > 0 such that whenever a set P of vertices of a planar graph G are precolored and are mutually at distance at least d from one another, the precoloring extends to a 5-list-coloring of G. In this talk we give some partial affirmative answers to Albertson's question and investigate the extent to which Thomassen's theorem and Albertson's question are best possible. This talk includes joint work with co-authors Maria Axenovich, Alice M. Dean, and Michelle A. Lastrina.

Ribbon graphs and twisted duality
Speaker: Jo Ellis-Monaghan, St. Michael's College

Abstract: We consider two operations on the edge of an embedded (or ribbon) graph: giving a half-twist to the edge and taking the partial dual with respect to the edge. These two operations give rise to an action of ${S_3}^{e(G)}$, the ribbon group of G, on G. We show that this ribbon group action gives a complete characterization of duality in that if G is any cellularly embedded graph with medial graph G_m, then the orbit of G under the group action is precisely the set of all graphs with medial graphs isomorphic (as abstract graphs)

to G_m. We then show how this group action leads to a deeper understanding of the properties of, and relationships among, various graph polynomials, Petrie duals, and some knot and link invariants. This is joint work with Iain Moffatt.

On generalized configurations
Speaker: Brigitte Servatius, WPI

Abstract: We consider generalized configurations as defined by Konrad Zindler (1890) and study their degree of irregularity and their automorphism group. We give a construction of a family of such configurations of arbitrarily large degree of irregularity. This is joint work with Tomaz Pisanski.

Symmetry Breaking in Matroids
Speaker: Jenny McNulty, The University of Montana

Abstract: What can we do to an object to break its symmetry?" That is, how can we restrict the object in some way so that the only automorphism is trivial? We examine two approaches. The first involves distinguishing the elements of the object while the second involves fixing some of the elements. Distinguishing and fixing numbers were originally defined for graphs. We are interested in the extension of these ideas to matroids. We give a sampling of fixing and distinguishing number results for matroids.

Sunday (8:30 am – 10:30 am)

The Combinatorialization of Linear Recurrences
Speaker: Jennifer Quinn, University of Washington, Tacoma

Abstract: Binet's formula for the nth Fibonacci number, $F_n = \frac{1}{\sqrt{5}} \left(\frac{1+\sqrt{5}}{2}\right) ^n - \frac{1}{\sqrt{5}} \left(\frac{1-\sqrt{5}}{2}\right)^n,$ is a classic example of a closed form solution for a homogenous linear recurrence with constant coefficients. Proofs range from matrix diagonalization to generating functions to index-chasing proofs by strong induction. Could there possibility be a better way? A more visual approach? A combinatorial method?

This talk introduces a combinatorial model using weighted tiles. Coupled with a sign reversing involution, Binet's formula becomes a direct consequence of counting exceptions. But better still, the weightings generalize to find solutions for any homogeneous linear recurrences with constant coefficients.

Matching Algorithms and their Applications
Pallavi Jayawant, Bates College

The classical one-to-one matching problem is about matching two groups of people taking into consideration the ranked preferences of every member of each group over the members of the other group. In general, the expectation is that the resulting matching should be stable in the sense that no two people should get better ranked partners by simply switching their partners. When it comes to matching people to institutions, the one-to-one problem generalizes to the many-to-one matching problem as in this case more than one person can be matched to the same institution. Again there is a notion of stability associated with these matchings. I will talk about these matching problems and the algorithms that help us obtain stable matchings in each case. I will also discuss applications of these algorithms with particular focus on the hospital/resident problem and the ways in which we can try to address some of the issues that arise due to its difference from the classical problem.

Graphs of Polytopes
Marge Bayer, University of Kansas

A well-known theorem of Steinitz says that a graph G is the graph of a 3-dimensional polytope if and only if G is planar and 3-connected. No such characterization is known for the graphs of convex polytopes of higher dimensions. However, it is known that the graph of every d-dimensional polytope is d-connected and contains a subdivision of the complete graph K_{d+1}. The nonexpert in polytopes may be surprised to learn that for every $n \geq5$ and every d, $4 \leq d \leq n- 1$, there is a d-dimensional polytope whose graph is K_n. The graph of an n-dimensional crosspolytope (generalized octahedron) is the n-partite graph $K_{2,2,\dots , 2}$. William Espenschied determined the dimensions d for which there exists a d-dimensional polytope with graph $K_{2,2,\dots , 2}$. As time permits, we discuss other results and questions about graphs of polytopes.

Extremal set theory and the weak order on the symmetric group
Susanna Fishel, Arizona State University

Extremal set theory is the combinatorial study of families of finite sets: how large or small a family with a given property can be, and what structure is found in extremal cases. For example, the Erdos-Ko-Rado Theorem gives the maximum size of a family of pairwise intersecting k-subsets of {1,,,,n}. We consider similar questions. However, instead of the boolean poset, we study the weak order on the symmetric group, where we replace "intersecting" with "meet at rank at least one." This is joint work with Glenn Hurlbert, Karen Meagher, Vikram Kamat.