Schedule and Abstracts

Discrete Math Days in the Northeast at URI
September 29, 2018

Time	Event	Location
9:00	Registration and Coffee	Outside Lippitt 401
9:45	Opening remarks	Lippitt 402
10:00	Sandra Kingan	Lippitt 402
11:00	sarah-marie belcastro	Lippitt 402
12:00	Lunch	Lippitt 401
1:00	Poster session	Lippitt 401
1:30	Bruce Sagan	Lippitt 402
2:30	Lenore Cowen	Lippitt 402
3:30	Coffee break	Lippitt 401
4:00	Padraig Ó Catháin	Lippitt 402
5:30	Dinner	TBD

Speaker: Sandra Kingan, Brooklyn College, CUNY
Time: 10:00-10:50
Title: Excluded Minor Results in Matroids

Abstract

In this talk I will begin with an overview of matroids and excluded minor results. For a given class of matroids with a specified structure, a minimal excluded minor is a matroid that is not in the class, but every single-element deletion and contraction is in the class. Such matroids are minimal obstructions for membership in the class. For example, the complete graph on five vertices K_5 and the complete bipartite graph $K_{3,3}$ are minimal obstructions to planarity. Several classes of matroids such as binary, ternary, and quaternary matroids can be characterized in terms of their minimal obstructions.

The opposite approach to excluded minor problems is to select a certain set of matroids for exclusion and to describe the structure of the resulting class. Matroid results of this type were initiated by Seymour in his 1980 paper on the decomposition of regular matroids. A matroid is regular if it has no minor isomorphic to the Fano matroid or its dual. Seymour proved that 3-connected regular matroids are either graphs, cographs, or a special 10-element matroid R_{10} called a splitter, or else can be decomposed along a non-minimal exact 3-separation induced by another special matroid R_{12} called a 3-decomposer. Quasiregular matroids are binary matroids with no minor isomorphic to a 10-element rank 5 self-dual binary matroid called E_4. The class of quasiregular matroids properly contains the class of regular matroids. I will describe how I decomposed quasiregular matroids in a manner similar to regular matroids. A portion of this talk is joint work with Manoel Lemos.

Speaker: sarah-marie belcastro, Smith College
Time: 11:00-11:50
Title: Color-induced subgraphs of Grünbaum colorings of triangulations

Abstract

Central in topological graph theory is the idea of an embedding—a graph drawn on a topological surface without edges crossing. As background, we'll give details on embeddings, review the classification of surfaces, and describe what is known about proper edge coloring of embedded cubic graphs.

In the current work, we consider properly edge 3-colored cellularly embedded cubic graphs and their dual Grünbaum-colored triangulations (and we will explain what all that means). The collection of edges of a single color induces a matching in the cubic graph and, in the dual triangulation, a color-induced subgraph (CISG).

Previous study of CISGs has focused on the properties of an embedding corresponding to all CISGs being connected. Here we discuss the relationship between the presence of an edge 2-colored Hamilton cycle in a cubic graph and the structure of a corresponding CISG in the dual triangulation; this structure depends on the embedding surface. We also consider the circumstances under which multiple CISGs are trees.

This work is joint with Ruth Haas.

Speaker: Bruce E. Sagan, Michigan State University, sagan@math.msu.edu
Time: 1:30-2:30
Title: Combinatorial interpretations of Lucas analogues

Abstract

The Lucas sequence is a sequence of polynomials in s, t defined recursively by $\{0\} = 0$, $\{1\} = 1$, and $\{n\} = s\{n-1\}+t\{n-2\}$ for $n \geq 2$. On specialization of s and t one can recover the Fibonacci numbers, the nonnegative integers, and the q-integers $[n]_q$. Given a quantity which is expressed in terms of products and quotients of nonnegative integers, one obtains a Lucas analogue by replacing each factor of n in the expression with $\{n\}$. It is then natural to ask if the resulting rational function is actually a polynomial in s and t and, if so, what it counts. Using lattice paths, we give combinatorial models for Lucas analogues of binomial coefficients. We also consider Catalan numbers and their relatives, such as those for finite Coxeter groups. This is joint work with Curtis Bennett, Juan Carrillo, and John Machacek.

Speaker: Lenore Cowen, Tufts University
Time: 2:30-3:30
Title: Random Walk Methods in the Analysis of Biological Networks

Abstract

Many of the computational methods that seek to leverage high-throughput information currently being generated about genes and genetic modules driving disease deal with a representation of some of that information in the form of a massive graph, where there are vertices for each gene or protein, and two genes or proteins are connected by an edge if there is evidence that there is some form of association. For example, in the PPI network, vertices are proteins, and two proteins are connected by an edge if there is experimental evidence that they physically bind in the cell. Like many other graphs that arise from applications in biological or social sciences, these graphs tend to be organized according to the principle that the social scientists call homophily, the tendency of vertices to share similarities with their direct connections. Applications that perform inference or other general machine learning tasks to mine such graph data, typically encode the similarity (or disimilarity, in the case of a distance metric), according to some measure of graph proximity. Finding the right network-based measure of dissimilarity, customized for the application at hand, can lead to valuable new insights. We survey some of the methods based on random walks on graphs that have been applied to biological network applications, and discuss in particular applications and open problems concerning our novel Diffusion State Distance metric.

Speaker: Padraig Ó Catháin, Worcester Polytechnic Institute
Time: 4:00-4:50
Title: Morphisms of complex Hadamard matrices

Abstract

Let M be a matrix with complex entries of unit norm. A well-known theorem of Hadamard bounds the magnitude of the determinant of M as a function of its dimension. We say that M is a complex Hadamard matrix (CHM) if M meets Hadamard's bound with equality.

Real Hadamard matrices are intimately connected to block designs and coding theory, and have been well studied in the literature. Certain classes of CHMs have been investigated more recently due to connections with quantum computing, but there is not yet a well-developed theory for their existence. In this talk I will survey the literature on CHMs with entries from the k^{th} roots of unity. I will report on recent joint work with Ronan Egan and Eric Swartz on the existence of tensor-product-like maps which reduce the number of entries in certain families of CHMs at the cost of increasing the dimension. This work generalises previous constructions of Turyn and Compton-Craigen-de Launey for real Hadamard matrices from certain CHMs.