KENNESAW STATE UNIVERSITY

College of Science and Mathematics

Department of Mathematics

MATH TALKS 2016 – 2017

Thursday, September 8, 2016

SPEAKER: John McCuan, Georgia Institute of Technology

TITLE: *"Euler's elastic curves and special liquid shapes"*

ABSTRACT: Euler classified all planar curves whose curvature depends linearly on one of the plane's coordinates. He called these curves elastica and used them to model a bending flexible rod. Some qualitative and quantitative questions about these curves have recently become important in application to liquid equilibrium shapes. This talk is built around one such question, and the speaker will attempt to also describe some of the applications. There will be some use of conserved quantities and phase plane diagrams as often included in a course on ordinary differential equations.

Thursday, September 22, 2016

SPEAKER: Michael Lacey, Georgia Institute of Technology

TITLE: *"One Bit Sensing"*

ABSTRACT: A signal is a high dimensional vector x, and a measurement is $a \cdot x$ for appropriately chosen a. Compressive sensing shows that under reasonable assumptions on x, you can recover it exactly, with very few measurements, in particular many fewer than the dimension of x. I will explain this, and then discuss one bit sensing where you only keep the sign of the dot product $a \cdot x$. Remarkably, one bit measurements can be just as effective as linear measurements.

Thursday, October 6, 2016

SPEAKER: Dhruba Adhikari, Kennesaw State University

TITLE: *"Topological degree Theory and some Applications"*

ABSTRACT: The talk will begin with an introduction to topological degree theory in finite-dimensional spaces. Applications to the fundamental theorem of algebra and to differential equations arising from ecology for the existence of equilibria will be discussed. If time permits, applications of topological degree theories to the invariance of domain results in analysis will also be discussed.

Thursday, October 13, 2016

SPEAKER: Ted Dobson, Mississippi State University and the University of Primorska

TITLE: *"Vertex-Transitive Graphs"*

ABSTRACT: A graph Γ is vertex-transitive if its automorphism group $\mathrm{Aut}(\Gamma)$ acts transitively on the vertex set $V(\Gamma)$ of the graph. That is, if for every $x, y \in V(\Gamma)$, there exists $\Upsilon \in \mathrm{Aut}(\Gamma)$ such that $\Upsilon(x) = y$. Intuitively, a graph is vertex-transitive if it is not possible to distinguish between vertices. Many important graphs are vertex-transitive graphs (e.g. the Petersen graph, the Coxeter graph), and vertex-transitive graphs are important in chemistry and theoretical computer science, amongst other areas. Recently, vertex-transitive graphs have received a fair amount of interest.

The purpose of this talk is to introduce what I consider some of the main problems (or perhaps just some of my favorite problems) in the study of vertex-transitive graphs, as well as indicate the kinds of results that have been and are currently being obtained concerning these problems. These problems include determining the full automorphism group of a vertex-transitive graph, determining necessary and sufficient conditions for two vertex-transitive graphs to be isomorphic, and Lovász's conjecture that every connected vertex-transitive graph contains a Hamilton path. By determining the automorphism

group, we mean either an explicit list of groups, or a polynomial time algorithm to list a set of generators of the automorphism group. By "necessary and sucient conditions for two graphs to be isomorphic" it is usually meant an explicit list L of maps, and two vertex-transitive graphs with a common minimal transitive subgroup are isomorphic if and only if they are isomorphic by a map on L.

Thursday, October 20, 2016
SPEAKER: Michael Lott, Kennesaw State University
TITLE: *"Diffusion Reaction Equations and how to solve them using Random Walks"*
ABSTRACT: A gentle introduction to Diffusion Reaction Equations and how to solve them using Random Walks. This is a variation of the Monte Carlo Markov Chains algorithm which we saw on Math Talks the last semester.

Thursday, October 27, 2016
SPEAKER: Jun Ji, Kennesaw State University
TITLE: *"Tensor Operations for Large-Scale Data Analysis"*
ABSTRACT: This week on Math Talks we will discuss the math necessary to play with big data. We will talk about the basic tensor operations for large-scale data analysis. This will be a brief introduction to tensors. We will discuss how to visualize high order tensors and study a few basic tensor operations.

Thursday, November 3, 2016
SPEAKER: Farzan Jafeh, Kennesaw State University
TITLE: *"Sample Industry Projects of a Recent Graduate, an Overview"*
ABSTRACT: In this talk, I will share a sample of my industry projects in analytics and big data. This includes a short background, introduction to the statement of each problem and analytically solutions.

Thursday, November 10, 2016
SPEAKER: Eve Torrence, Randolph Macon College
TITLE: *"Fun with Hyparhedra"*
ABSTRACT: In 2015 Eve Torrence's sculpture "Day" was awarded the "People's Choice Award" at the Bridges Conference Exhibit of Mathematical Art. This mathematical art piece solved a mathematical/artistic question "posed" by Eric Demaine of MIT. We will discuss the geometry of this sculpture and several others. Then we will learn how to fold hypars and build a group sculpture to help us further understand the geometry of these pieces. We will also discuss how looking at a problem from a different angle can be the key to the solution.

Thursday, November 17, 2016
SPEAKER: Christina Lee, Emory University
TITLE: *"Neuronal Network Sensory Processes"*
ABSTRACT: The brain is an amazingly complex living system, in which a myriad of simultaneous processes takes place on vast ranges of spatial and temporal scales.

While much too rich to be modeled in its entirety, for mathematicians, it presents specific modeling opportunities on levels ranging from the molecular through single neurons to even some brain areas.

And while the answers to questions such as "what is the mind?" or "what is a percept?" or "what is the neural code?" remain for now far out of our reach, mathematical models, grounded in experimental data, can be used to successfully hypothesize plausible mechanisms underlying some of the basic neuronal processing in areas such as early sensory pathways. Some of these models are surprisingly simple, including the integrate-and-fire and the firing-rate models, which are amenable both to numerical simulations as well as dynamical-systems and bifurcation analysis.

The talk will focus on describing some of the neuronal responses to stimuli arriving along the early visual and olfactory pathways.

Thursday, December 1, 2016
SPEAKER: Joseph Fadyn, Kennesaw State University
TITLE: *"Solving Quadratic Congruences Modulo a Prime"*
ABSTRACT: We will consider the problem of solving the quadratic congruence $ax^2 + bx + c = 0 \pmod{p}$ where p is an odd prime number. An important element in solving this congruence is the ability to extract square roots modulo a prime. This ability is also critical to certain cryptosystems like the elliptic curve cryptosystem. We will begin by reviewing some basic concepts of number theory and then concentrate on methods of finding square roots modulo a prime. Along the way we will encounter some classical number theory facts and some results which may look rather strange at first glance. This talk will be accessible to any undergraduate student of mathematics and will not require an extensive knowledge of number theory.

Thursday, February 2, 2017
SPEAKER: Chuck Dunn, Linfield College
TITLE: *"Clique-Relaxed Graph Coloring"*
ABSTRACT: We consider a variation of the following game played on a finite graph G. Two players, Alice and Bob, alternate coloring the uncolored vertices of G from a set of r colors. At each step, the players must ensure that adjacent vertices receive different colors. Alice always goes first. She wins the game if the entire graph is eventually colored; otherwise, Bob wins if there comes a time such that there is an uncolored vertex that cannot be colored. The least r such that Alice has a winning strategy for this game on G is called the game chromatic number of G. We will examine a variation of this game in which the players ensure that the subgraphs induced by the color classes have bounded clique size. Our focus with these variations will be on the classes of outerplanar graphs and planar graphs.

Thursday, February 23, 2017
SPEAKER: Olivia Beckwith, Emory University
TITLE: *"Patterns in Partitions"*
ABSTRACT: A partition of an integer n is a non-increasing sequence of positive integers whose sum is n. Counting partitions of integers, one finds surprising arithmetic patterns and connections to many fields, including number theory, q-series, the theory of modular forms, and the physical sciences. This talk will provide a broad overview of some of the classic theorems and some recent results in the study of integer partitions.

Thursday, March 2, 2017
SPEAKER: Susanna Molitoris Miller, Kennesaw State University
TITLE: *"Mathematics of Catan"*
ABSTRACT: We will learn about the mathematics of the mysterious land of Catan. The people of Catan are masters of combinatorics, probability and game theory. So, where is Catan? If you do not know join us and learn all about it.

Thursday, March 9, 2017
SPEAKER: Linda Galloway and Ludmila Orlova-Shokry, Kennesaw State University
TITLE: *"College Algebra course redesign: ALEKS based Emporium Format"*
ABSTRACT: The overall goal of the College Algebra course redesign project is to transform the learning environment so that each student is actively engaged in a learning process, has a consistent learning experience and consistent learning outcomes. Use of an adaptive learning software such as ALEKS as well as Emporium Model classes are gaining more recognition among educators. The main focus of this project is an integration of an adaptive learning software ALEKS and Emporium Model into College Algebra and Precalculus courses. In this talk, we will introduce an ALEKS based Emporium format College Algebra course design, will give a short introduction to ALEKS software, and will share our experience teaching with ALEKS.

Thursday, March 16, 2017
SPEAKER: Ken Keating, Lake Ritter, Jennifer Vandenbussche, Kennesaw State University
TITLE: *"Attempting to improve student outcomes in Calculus 1"*
ABSTRACT:

PART 1 (Ken): In my part of the talk I will discuss what I have done to flip my class. Included will be examples of the materials I created as well as a few lessons learned from the initial implementation in Fa16. In addition, I had students complete a multiple choice prereq-assessment and a skills self-assessment using a Likert-type scale at the beginning and end of the Fa16 semester. I will briefly discuss these items and the data that was collected.

PART 2 (Lake and Jenn): Lack of readiness, in terms of prerequisite skills, can be a major impediment to student success in Calculus 1. We will discuss an early remediation intervention program which includes a low stakes assessment at the beginning of the term. Students are then given the option to retake the assessment provided they perform targeted skill building tasks. In this talk, we will share details of the remediation program including the skill objectives, assessments, and materials used.

Attending a certain amount of office hour time with the instructor has been among the required tasks for students wishing to participate in assessment retake. This requirement, in particular, results in a significant workload for the instructor, and may inhibit replication of the program. We are currently conducting a study to determine the importance of this office hour requirement. Each author is teaching two sections of Calculus 1, one with and one without the office hour requirement. Through comparison of grades and student performance on select exam questions and through pre and post-surveys, we seek to determine whether there are appreciable differences in course outcomes and whether the office hour requirement impacts students' attitudes toward instructor office hours. Some preliminary impressions from this study will be presented.

Thursday, March 30, 2017
SPEAKER: Yuliya Babenko, Kennesaw State University
TITLE: *"The Art and Science behind Bezier Curves"*
ABSTRACT: String art and craft, so loved by many children and adults alike, have interesting – and useful! – mathematics in its roots. It also has a surprising connection to works of famous artists such as Pablo Picasso and renowned contemporary architects such as Santiago Calatrava. However, to those who even once tried to draw a curve on a computer these connections come as no surprise – they know the power of Bezier curves. In this talk we will look at a few examples of Bezier curves in art and sciences – and some mathematics behind them.

Thursday, March 30, 2017 – Infinite Horizons Lecture
SPEAKER: Moon Duchin, Tufts University
TITLE: *"Gerrymandering, geometry, and the shape of fairness"*
ABSTRACT: By controlling the shapes of voting districts, you can often predetermine the outcomes of elections. I'll try to convince you that geometry – from high-school geometry to new ideas at the research frontier – can help detect vote-rigging and promote democracy.