Sunday October 6

Session D: Oct 6

9:00 – 9:20
Presenter(s): Aleksei Talonov (University of Nevada, Las Vegas), Katlyn Cox (University of Nevada, Las Vegas) and Viktoria Savatorova (Central Connecticut State University)
Title: *Strategies to maximize learning and minimize failure in precalculus classes*
Abstract: We will present our practices of using Web-based audience response systems to enhance interactive learning activities in Mathematics classroom. We mostly concentrated our attention on PreCalculus classes which have had traditionally low success rates and retention. During the last couple of years, we have developed a set of course specific materials in the form of lecture notes and in-class and out-of-class assignments. Each major assignment is accompanied by clear and coherent guidelines explaining what kind of skills will be attained by practicing this assignment, how it can be done, what amount of time can it reasonably take, when is it due, and where to get help. Speaking of technology, in our practice we use online homework systems (WebAssign or Willey Plus), video materials, and Web-based audience response systems (Poll Everywhere). Enhancing a class with technology helps students to be better engaged with the concepts covered, better communicate with the instructor and their peers, check their understanding of the concepts and quickly get a feedback.
Talk theme(s): Education/Pedagogy
Audience: PreCalculus and Calculus

9:30 – 9:50
Presenter(s): Peyam Tabrizian (University of California, Irvine)
Title: *Using YouTube videos to promote learning inside and outside the classroom*
Abstract: I will describe my experience of using YouTube videos to promote learning both inside and outside the classroom. I currently have a channel called "Dr Peyam" which has over 30,000 subscribers and over 450 videos, on which I regularly post videos related to my lectures, like the 'Divergence Theorem' or 'Gaussian Elimination,' as well as others that are accessible to a wider audience, like 'Half Derivatives' or 'The Integral of x^x from 0 to 1.' Those videos are for students and people around the world who are interested in math, and the advantage is that anyone can watch them online or on their phones, and ask questions and comments. For my students in particular, I upload videos on topics covered in lecture, practice question videos, and videos on further topics. I am also holding virtual office hours by using the live stream option, so that the students can have office hours delivered right to their homes.
Talk theme(s): Education/Pedagogy

10:00 – 10:20

Presenter(s): Aubrey Kemp (California State University, Bakersfield)
Title: *Investigation of mathematical definitions in taxicab geometry with group work and dynamic geometry software*
Abstract: Research shows that the use of group work and technology in the classroom can be beneficial for students, and that students can better develop their understanding of concepts in Euclidean geometry by observing properties and making conjectures in other geometries. This study sought to improve student understanding of mathematical definitions as well as their application, since definitions are often not used correctly by students in proof or logic courses. Students in a College Geometry course worked in groups to explore concepts and complete activities on a dynamic geometry software, Geometer's Sketchpad (GSP). In GSP, students were guided to construct figures, observe properties, and make conjectures in geometry. During group work and class discussions, concepts were formalized, including the proofs of theorems that were explored in the activities in GSP. In this presentation, examples of activities given during a Taxicab geometry lesson are provided along with excerpts of student work in GSP. Data collected imply investigation using this software and participation in group work can help heighten student engagement and deepen understanding of various mathematical definitions and concepts.
Talk theme(s): Undergraduate Mathematics Education
Audience: Geometry and Active Learning

Session E: Sun 10/6

9:00 – 9:20
Presenter(s): Marshall Whittlesey (California State University, San Marcos)
Title: *Proving theorems in spherical geometry using the quaternions*
Abstract: It is well known that the complex numbers can be used to do transformation geometry in the plane. In particular, rotation by angle θ about the origin is accomplished via multiplication by the complex number $e^{i\theta} = \cos(\theta)+i\sin(\theta)$. It is less well known that the quaternion algebra (consisting of expressions of the form $a + bi + cj + dk$ with $i^2 = j^2 = k^2 = -1$) can be used to do similar transformations in three dimensional space. In this talk we show how to use quaternions to prove significant theorems in spherical geometry. These methods are featured in the speaker's new book with CRC Press *Spherical Geometry and its Applications*, which the author hopes will be attractive for use in topics courses in geometry.
Talk theme(s): Geometry
Audience: Trigonometry and complex numbers

9:30 – 9:50
Presenter(s): Alvaro Carbonero (University of Nevada, Las Vegas)
Other Author(s): Beth Anne Castellano (Lafayette College), Charles Kulick (Scranton University) and Karie Schmitz (Truman State University). Research advisors: Dr. Gary Gordon (Lafayette College) and Brittany Shelton (Albright College)

Title: *Exploring preference orderings through discrete geometry*
Abstract: Consider $n+1$ points in the plane: a set S consisting of n points along with a distinguished vantage point v. By measuring the distance from v to each of the points in S, we generate a preference ordering of S. This work is motivated by a voting theory application, where an ordering corresponds to a preference list. The maximum number of orderings possible is given by a fourth-degree polynomial (related to Stirling numbers of the first kind), found by Good and Tideman (1977), while the minimum is given by a linear function. We investigate intermediate numbers of orderings achievable by special configurations S. We also consider this problem for points on the sphere, where our results are similar to what we found for the plane. A variant of the problem that uses two vantage points is also developed.
Talk theme(s): Discrete Geometry
Audience: Basic combinatorics and geometry knowledge

10:00 – 10:20
Presenter(s): David Gove (California State University, Bakersfield)
Title: *Counting permucycles*
Abstract: Permucycles are inspired by DeBruijn Cycles, which are sequences that have a complete family of sequences as subsequences. DeBruijn cycles have been enumerated and there is a formula for the number of cycles based on the parameter that represents the length of the subsequence. We define a permucylce to be a sequence that has a complete family of permutations as subsequences. They are a two parameter family of cyclic sequences. We report on the search for a formula analagous to the DeBruijn Sequence formula.
Talk theme(s): Combinatorics, Graph Theory, and Linear Algebra
Audience: General

Session F: Sun 10/6

9:00 – 9:20
Presenter(s): Melody Ruth (San Diego City College)
Other Author(s): Research advisor: Dr. Rob Rubalcaba (San Diego City College)
Title: *Triple town and graph theory*
Abstract: In the game "Triple Town pieces of grass are placed such that three or more pieces of grass promote to a bush, three or more bushes promote to a tree, three or more trees promote to a red house, and so on until a castle is built. The game is played on a cartesian product of two paths of length six, though we generalize the game to any graph and define a sequence of ones to be promoted to 2, 3, etc according to the recursive promotion rules of the game.

We show that finding either the maximum or minimum total weight on any graph is an NP-hard problem, and that the decision versions are NP-complete. We investigate maximum (respectively minimum) total weights of an optimal terminating state of the Triple Town game on grid graphs and trees.
Talk theme(s): Discrete Mathematics, Complexity Theory

Audience: High School and Undergraduate students majoring in Math or Computer Science (no knowledge of graph theory required)

9:30 – 9:50
Presenter(s): Angel Hernandez Llamas (San Diego City College)
Other Author(s): Research advisor: Dr. Rob Rubalcaba (San Diego City College)
Title: *Chromatic number of unit-distance graphs in Euclidean spaces*
Abstract: The chromatic number of the plane is the minimum of colors needed to color the plane if no two points at unit distance one from one another are given the same color. The problem was first discussed by Nelson in 1950, and since then the chromatic number has remained unsolved, conjectured to be 4, 5, 6 or 7. Recently in 2018, due to discoveries by Aubrey De Gray, it is possible to narrow chromatic number to 5, 6 or 7, though the proofs of the new 5-chromatic constructions are computer assisted. We investigate 5-chromatic unit-distance De Gray graphs. We also investigate bounds on the chromatic number of unit-distance graphs in higher dimensional Euclidean spaces.
Talk theme(s): Graph Theory/Combinatorics
Audience: Undergraduate students (no knowledge of graph theory required)

10:00 – 10:20
Presenter(s): Mason Shurman (California State University, Los Angeles)
Other Author(s): Research Advisor: Dr. Daphne Liu (California State University, Los Angeles)
Title: *Optimal radio k-labeling of trees*
Abstract: In a graph G, the distance between two vertices u and v in G is denoted as $d(u,v)$, and the diameter of G is denoted as $\mathrm{diam}(G)$. In a graph model of the channel assignment problem, for a positive integer k, a *radio k-labeling* of G is a function $f : V(G) \to \{0,1,2,\ldots\}$ such that for any two vertices u,v in G, it holds that $|f(u)-f(v)| \geq k+1-d(u,v)$. The *span* of f is defined by $\max\{|f(v)-f(u)| : u,v \in V(G)\}$. The *radio k-number* of G, denoted as $rn_k(G)$, is the minimum span of a radio k-labeling admitted by G. For the special case when $k = \mathrm{diam}(G) = d$, a radio d-labeling is called a *radio labeling* for G. The *radio number* of G is denoted as $rn(G)$ where $rn(G) = rn_d(G)$. For a tree T with n vertices and diameter d, it is known that $rn(T) \geq (n-1)(d+1) - 2w(T) + 1$, where $w(T)$ is the weight of T. We call a tree whose radio number is equal to this a *lower bound tree*. We establish properties of lower bound trees, and show how lower bound trees can be combined in certain ways to create other lower bound trees.
Talk theme(s): Applied Mathematics and Graph Theory
Audience: Graph Theory/Combinatorics