100th Meeting of the Southeastern Section of the Mathematical Association of America, March 5th, 6th, 12th, and 13th, 2021

Abstracts of Talks and Posters

Contents

Special Sessions on Recreational Mathematics

REC1.1 **Joshua Siktar** (jsiktar@vols.utk.edu). *Ballot Box Bogglers: Unexpected Connections Between Voting and Fairness*
Additional authors (if any): Dr. Jeneva Clark, University of Tennessee-Knoxville

Casting a ballot is a simple civic duty, but surprisingly, counting those votes can be mathematically nuanced and puzzlingly paradoxical. Using preference tables, we will discuss plurality, plurality with elimination, the Borda count, and pairwise comparison. These methods are analyzed using a framework of four fairness principles: majority, condorcet, monotonicity, and the independence of irrelevant alternatives. We also investigate how the methods can violate fairness principles, and we identify pedagogical advantages of including this topic in a mathematical reasoning course.

REC1.2 **John J McKinley** (Jaybirdmac@gmail.com). *Pattern, Conjecture, Proof, Application*
Additional authors (if any):

The presenter shows a complete way to list the natural number sum of two squares=sum of two squares in four variables based on the factorization of the natural numbers into distinct pairs of co-factors. The slides show the progression from discovering the pattern, making and proving two conjectures from the pattern, to a brief video application of an equilibrium demonstration useful for high school students or above.

REC1.3 **Douglas A. Torrance** (dtorrance@piedmont.edu). *Enumeration of planar Tangles*
Additional authors (if any):

A planar Tangle is a smooth simple closed curve piecewise defined by quadrants of circles with constant curvature. We can enumerate Tangles by counting their dual graphs, which consist of a certain family of polysticks. The number of Tangles with a given length or area grows exponentially, and we show the existence of their growth constants by comparing Tangles to two families of polyominoes.

REC1.4 **Jeff Clark** (clarkj@elon.edu). *How Do We Know There are 43,252,003,274,489,856,000 Different Positions for Rubik's Cube?*
Additional authors (if any):

Rubik's Cube has been around since 1974 and is one of the world's best-selling puzzle games. There are a total of 43,252,003,274,489,856,000 different positions for the cube. How is this number computed? This talk will briefly outline the group theory behind the computation.

REC2.1 **Ryan D Fox** (ryan.fox@belmont.edu). *Howie meets Monty: Mathematical activity in the synthesis of two game shows*
Additional authors (if any):

Elements from the television game shows "Let's Make A Deal" and "Deal or No Deal" are combined in this talk to create a mathematical activity.

REC2.2 **Isac VanWormer** (ivanwormer@my.apsu.edu). *Domination and Independence of Diamond Chessboards*
Additional authors (if any): Dr. Brad Fox (Austin Peay State University)

A diamond chessboard is a board with central axes of length n with rows and columns decreasing in length by two squares until a diamond shape is created. We consider domination and independence numbers of n-by-n diamond chessboards with respect to certain types of chess pieces. Particularly, we state the domination and independence numbers of rooks, bishops, and kings on diamond chessboards.

REC2.3 **Tricia Muldoon Brown** (tmbrown@georgiasouthern.edu). *Counting Nonattacking Independent Kings*
Additional authors (if any):

The problem of finding and counting non-attacking, arrangements of pieces on a chessboard is a long-established problem in mathematics and computer science. In this talk, we will provide a formula that enumerates the non-attacking arrangements of kings on even-length square or rectangular chessboards. In addition, we present an overview of the history of the problem and if time permits will demonstrate computations using Mathematica.

Special Session on Mathematics Outside of Teaching Math

OUT.1 **Lisa Jones** (lisa.m.jones364.mil@mail.mil). *Mathematics in Cyber Security*
Additional authors (if any):

What do graph algorithms and category theory have to do with big data and network intrusion detection systems? How does mathematical logic relate to software security? As an active duty Army Cyber officer, I've found my discrete mathematical training to be indispensable when approaching highly interdisciplinary problems in a national security setting. I am currently an applied research mathematician in the National Security Agency's Applied Mathematics Program. Previously, I worked as a software engineer at the Defense Digital Service and the Cyber National Mission Force. In this talk, I will discuss my experiences in applying mathematics to computer security problems while serving in roles across the U.S. Department of Defense. I will also present an example which imparts the flavor of my recent research: applying satisfiability modulo theories (SMT) solvers to finding security vulnerabilities in programs.

OUT.2 **Michael Stemper**. *Mathematics in Electric Utility Operations*
Additional authors (if any):

Electric utilities are mostly taken for granted, until their product is missing (as recently happened in Texas). The general assumption is that when one flips a switch or plugs in a charger, the energy will be ready and waiting to flow. That this is usually true is due to the fact that thousands of engineers across the country are constantly analyzing the state of their part of the grid, examining what the consequences would be if any piece of equipment was lost, planning for expected maintenance activities, and scheduling resource deployments for the next hour, the next day, and the next year. This talk will give an overview of some of the mathematical tools in the utility engineer's toolbox.

OUT.3 **Lauren Huckaba**. *Opportunities in Mathematics Outside of Academia*
Additional authors (if any):

There is a great variety of government job opportunities for mathematicians. In this talk, we'll discuss how mathematics is used in some of these jobs, what areas of mathematics appear frequently, and how students and recent graduates can find their ways to these interesting positions.

OUT.4 **H. Tracy Hall**. *Perspectives in industrial modeling*
Additional authors (if any):

Although I am still active in pure mathematics research, my day job is as an applied mathematician doing scientific and mathematical modeling. I will share examples from some problems I have worked on, with the goal of a perspective on the sort of skills and background from mathematics that can be useful in an applied industrial setting.

OUT.5 **Robert Gill**. *Monte Carlo Ray Tracing and its Application in Concentrating Solar Power Technologies*
Additional authors (if any):

A methodology is presented that uses Monte Carlo Ray Tracing (MCRT) to characterize a high-flux solar simulator and prototype a solar-thermochemical reactor for use with concentrating solar power (CSP) technology. The complexity of CSP systems creates a need for powerful numerical simulation systems such as MCRT. MCRT transforms the radiative heat transfer equation, a complex partial differential equation, into a series of stochastic trigonometric interactions between photons and surfaces. The results are used to determine the radiative output from concentrating facilities as well as solar concentrations on reactors/receivers.

OUT.6 **Daniel Hawthorne**. *Where we are going, and where we have been: Cryptography, security, technology*
Additional authors (if any):

Technology relies on security. Security relies on cryptography, which includes a lot of math. If cryptography suffers a setback, so will all of our technology. This talk reviews the history and foundations of cryptography, lessons learned from past setbacks, and leads up to the risks to cryptography today. It concludes by challenging students to remain aware of the importance of cryptography and seek solutions in the field.

Special Sessions on Opportunities in Data Science for Undergraduate Programs

DSC1.1 **R. N. Uma** (ruma@nccu.edu). *Data Science: A Tool for Recruitment and Broadening Participation?*
Additional authors (if any): Alade Tokuta (NC Central University), Rebecca Zulli Lowe (Cynosure Consulting), Adrienne Smith (Cynosure Consulting), and Gaolin Milledge (NC Central University)

Data science is a burgeoning STEM field that focuses on applications across many areas in society, e.g., health care, law enforcement, and education, to name a few. In the Department of Mathematics & Physics at NC Central University, we have incorporated data science into the undergraduate program in two ways.

First, we incorporated data science into a concentration for Mathematics majors. Through an NSF-funded Targeted Infusion Grant (NSF HRD#1533653) we developed a new Computational and Engineering Mathematics (CEMA) concentration for our Mathematics majors with special emphasis on the following themes: Data Science, Software Engineering, Computational Science, and jointly with NC State University Computer Engineering, and Electrical Engineering.

Second, we aim to use data science as a vehicle to broaden participation and increase enrollment in STEM, particularly Mathematics. Underrepresentation in STEM is a persistent problem. Despite research identifying and addressing many of the prerequisite factors for recruitment and persistence in STEM (e.g., self-efficacy, sense of belonging), underrepresentation remains a problem. Best

practices in teaching pedagogy stresses the importance of incorporating personally relevant contexts and scenarios to maximize student engagement. Our ongoing NSF-funded project (NSF HRD#1912408) not only makes STEM feel personally relevant but also signals a call to action by grounding instruction in social justice. Situating STEM as a vehicle for dissecting social inequities and promoting social justice, is a novel approach to STEM instruction and one that is likely to have broad appeal for many underrepresented groups in STEM. Data Science offers the ideal starting point for highlighting to students how STEM provides a meaningful avenue for pursuing social justice and affecting policy changes.

DSC1.2 **Jeff Lawson** (jlawson@wcu.edu). *Data Science at Western Carolina University*
Additional authors (if any): Andrew Penland, Western Carolina University; John Wagaman, Western Carolina University

In recent years, many institutions have initiated degree programs in data science at both undergraduate and graduate levels. Western Carolina University started a concentration in data science within the undergraduate mathematics program in Fall 2018, and we have launched a graduate certificate program which began in Fall 2020. The programs have curricular synergies so that a full-time undergraduate student could potentially earn both a B.S. in Mathematics and a Graduate Certificate in Data Science in four years plus one additional summer. The graduate certificate targets students who have quantitative undergraduate degrees in mathematics, statistics, computer science, or engineering, but it is accessible to a wider audience, requiring only a background in calculus, statistics, and programming. Both programs are informed by guidelines from the American Statistical Association and are taught in a combined mathematics and computer science department, with broad faculty expertise. In this talk, we present the process of creating the programs, the curriculum, and the populations we currently serve and plan to serve. We conclude with an example problem from of one of our courses.

DSC1.3 **Zach Abernathy** (abernathyz@winthrop.edu). *Our Journey Toward an Undergraduate Program in Data Science*
Additional authors (if any):

Over the past five years, several members of the Winthrop math department have made efforts to increase their expertise in data science and industrial mathematics in order to help math majors who want to enter the industry upon graduation. This has culminated in proposing an undergraduate program in data science. In this talk, we'll discuss how we built the program around our current curricular structure and challenges we've faced along the way.

DSC1.4 **Michael Lamar** (michael.lamar@centre.edu). *Building Data Science at a Small Liberal Arts College*
Additional authors (if any):

The small liberal arts college environment presents unique challenges and unique opportunities for the study of data science. Creating a new academic program from scratch is a complicated undertaking due to the many invested parties and their competing interests. We discuss the lessons we learned as we designed a data science major and minor that appealed to -- or at least appeased -- the faculty, students, and college administrators alike. We also share the benefits we are seeing for

our students as our first class of majors nears graduation as well as the new challenges we now face as increasing enrollment in the program strains the available resources.

DSC2.1 **Holly Rosson** (hrosson@warren-wilson.edu). *Introducing a Data Science Minor at a Liberal Arts College*
Additional authors (if any):

We discuss the motivation, some challenges and rewards of introducing a Data Science Minor at a small liberal arts college with a traditional mathematics curriculum.

DSC2.2 **Kristen Abernathy** (abernathyk@winthrop.edu). *In the Trenches: A First-Hand Look at the Skills Data Scientists Need*
Additional authors (if any): Zach Abernathy, Winthrop University

The goal of any program is to produce graduates ready to enter today's workforce. In order to better understand the skills data scientists utilize on a daily basis, we consulted for a local data science company last year. This experience was rich in lessons to instill in our students that will better prepare them for careers in data science. During this talk, we'll discuss these lessons learned and our plans to infuse them into our curriculum.

DSC2.4 **Mingwei Sun** (msun1@samford.edu). *Penalized Regressions with Different Tuning Parameter Choosing Criteria and the Application in Economics*
Additional authors (if any): Sheng Gao, Samford University

Recently a great deal of attention has been paid to modern regression methods such as penalized regressions which perform variable selection and coefficient estimation simultaneously, thereby providing new approaches to analyze complex data of high dimension. The choice of the tuning parameter is vital in penalized regression. In this paper, we studied the effect of different tuning parameter choosing criteria on the performances of some well-known penalization methods including ridge, lasso, and elastic net regressions. Specifically, we investigated the widely used information criteria in regression models such as Bayesian information criterion (BIC), Akaike's information criterion (AIC), and AIC correction (AICc) in various simulation scenarios and a real data example in economic modeling. We found that predictive performance of models selected by different information criteria is heavily dependent on the properties of a data set. It is hard to find a universal best tuning parameter choosing criterion and a best penalty function for all cases. The results in this research provide reference for the choices of different criteria for tuning parameter in penalized regressions for practitioners, which also expands the nascent field of applications of penalized regressions.

DSC2.5 **Fidele Ngwane** (ngwanef@mailbox.sc.edu). *Modeling drought in South Carolina*
Additional authors (if any):

Drought is a serious problem in South Carolina and the USA. In this presentation, we examine drought trends in South Carolina using data analysis techniques. Using publicly available data, we construct statistical models for future drought forecast.

Special Sessions on Inquiry-Based Learning in Online and Socially Distanced Classrooms

IBL1.1 **Joseph Spivey** (spiveyja@wofford.edu). *IBL Techniques for Hybrid First-Year Seminar Math Class*
Additional authors (if any):

This talk is about implementing Inquiry-Based-Learning (IBL) techniques in a hybrid or remote (synchronous) environment. I used IBL in a first-year seminar whose topic was, broadly speaking, "What is mathematics?" This was a small in-person class, where students sat 6 feet apart and worked in groups to understand the "why" of mathematics. I will share tips on how I successfully implemented IBL during a pandemic, including the use of the Discord app (a Zoom alternative) to allow remote participation. The principles that worked to encourage learning in this new IBL environment are equally applicable for in-person instruction. I will share the principles that worked for me in the hopes that they will help others implement IBL (whether in a hybrid, remote, or in-person environment).

IBL1.2 **Jacob Dennerlein** (jdennerl@vols.utk.edu). *If You Hopped Like a Frog: Group Work and Creativity in an Online Setting*
Additional authors (if any): Dr. Jeneva Clark (UT Knoxville)

During normal, in-person classes, group work often takes the form of a circle of desks, where the students are passing papers around, and looking over each other's shoulders. In an online setting, the circle of desks is replaced with breakout rooms, but the papers of other students have become intangible. In this talk, we discuss the use of Google Jamboards in Math 113 at UT Knoxville, and how we've used them to bring structured inquiry to our online classrooms. We also show how students have taken advantage of this space to express their creativity.

IBL1.3 **Jessie Hamm** (hammj@winthrop.edu). *Teaching an IBL Intro to Proofs course Virtually*
Additional authors (if any):

Inquiry based learning and virtual learning are not terms I would say go together. In fact, teaching IBL in a virtual setting seems a bit impossible. However I am hear to tell you that it's not and that it can actually work incredibly well! In this talk I will share how I adapted my in person IBL Intro to Proofs course to a virtual synchronous setting. I will discuss a variety of tools and strategies I used to implement IBL successfully.

IBL1.4 **Phong Le** (phong.le@goucher.edu). *Online Combinatorics IBL: A team sport.*
Additional authors (if any): None

Last semester I taught an upper level Combinatorics course online using an inquiry-based learning format. As with all IBL courses, the goal was the shift the power and authority dynamic. While we reproduced some of the familiar in-person methods, I also tried to embrace the online format and online collaborative tools to provide space for different types of inquiry and interaction. I'll be discussing some of these techniques and the response I got from students.

IBL1.5 **Jessica Sorrells** (jessica.sorrells@converse.edu). *Digitally Collaborative IBL in Abstract Algebra*
Additional authors (if any):

This talk will highlight strategies and technology utilized to implement inquiry-based learning in a hybrid Abstract Algebra course during Fall 2020. Focus will be on methods allowing students to collaborate on proof attempts as well as the structure of course notes and problem sets.

IBL2.1 **Allie Ray** (adray@bsc.edu). *Maintaining Student Interactions in a Socially Distanced IBL Classroom*
Additional authors (if any):

Two of the pillars of inquiry-based learning (IBL) are students collaborating on mathematics and instructors inquiring into student thinking. These often take place through student-student and student-faculty interactions during class time. I will discuss how I worked to preserve these meaningful interactions in a socially distanced Calculus 1 classroom. Techniques included the use of individual student whiteboards and can be adapted to other classroom environments.

IBL2.2 **Vicky Klima** (klimavw@appstate.edu). *Classroom poster presentations*
Additional authors (if any):

We center students' inquiry when we ask them to discuss their reasoning with others. Poster presentations give the presenter an opportunity to explain their process and their findings while the intimate nature of poster presentations encourages meaningful conversation between presenter and viewer. We present classroom models incorporating regular poster presentations, adapting lower-level problem sessions and upper-level direct instruction to the poster setting. This talk emphasizes tools for transitioning poster presentations to virtual classrooms including asynchronous video presentations with discussion boards and synchronous breakout room presentations with Google Jamboards.

IBL2.3 **Joel Louwsma** (jlouwsma@niagara.edu). *Student presentations in socially distanced classrooms*
Additional authors (if any):

I will discuss my Fall 2020 introduction to proofs course, which was centered around student presentations. This class primarily met in person, with masks and social distancing; students in quarantine also joined via Zoom. For the last two weeks of the semester, all class meetings were held online. I will describe how we were able to overcome some logistical challenges to have a largely successful IBL experience.

IBL2.4 **George Moss** (gmoss@uu.edu). *Oral Quizzes in Online and Face-to-Face Classes*
Additional authors (if any):

For the past year I have successfully used oral quizzes in statistics, precalculus, and differential equations. Initially motivated to find an assessment that was difficult to cheat on, I have since

realized other benefits of oral assessment. By assigning problems in advance, allowing students to use any resources to prepare, and permitting the use of notes, students are more prepared and less anxious. Under these circumstances oral quizzes give students an alternative method to exhibit their learning, help them develop oral communication skills, and encourage them to work together for deep learning. They also give me a chance to interact with each student individually, which is especially beneficial in online classes. In this talk I will share my experience as well as some of the literature on oral assessment in mathematics.

General Contributed Paper Sessions

CP1.1 **Amanda Mangum** (amanda.mangum@converse.edu). *Implementing an Online Self-Directed ALEKS Bridge Course for Algebra Skills Using Standards Grading*
Additional authors (if any):

The newly created algebra bridge course at Converse College was moved online during the Fall 2020 semester. This iteration had a higher success rate than the previous iteration which was held in person. The details of how the course was structured, highlighting changes with these desired improvements in view, will be discussed.

CP1.2 **Yuanting Lu** (lu_y@mercer.edu). *Teaching Introductory Statistics with R and R Shiny Apps*
Additional authors (if any):

The early adoption of R in introductory statistics can flat the learning curve for students who will use it in the future. The open-source nature of R along with its powerful computational and visualization features can stimulate students' interests in the course and improve their understandings on statistical concepts. In addition, the use of R Shiny apps in running simulation, collecting and visualizing data, and randomizing assignments can make the class more interactive and engaging.

CP1.3 **Chad Mangum** (crmangu@clemson.edu). *Engagement in Medium-Sized, Remote Mathematics General Education Class Setting*
Additional authors (if any):

The sudden increase in online, remote learning at the college level has changed the landscape of student engagement. In this talk, I will discuss a number of course design decisions that were made for use in the general education mathematics course at Clemson University in the 2020-2021 school year, a course in which most students participated synchronously, but remotely. The course elements to be highlighted were designed to promote student engagement in this format, and it is my hope that they will serve as a springboard for further innovations in this vein.

CP1.4 **Lindsay Grinstead** (egrinste@vols.utk.edu). *Teaching Math with Food Manipulatives*
Additional authors (if any): Lee Spence, University of Tennessee

Students can discover geometric relationships by taking shapes and breaking them, folding them, rearranging them, and â€¦ eating them? Well, not exactly, but the use of edible manipulatives can

help anchor geometric meaning to our physical, tangible world. In this session, we will demonstrate two innovative hands-on activities in which students use food to construct formulas. Rearranging pancake pieces leads to the area formula for circles, and peeling a clementine leads to the surface area of a sphere. After demonstrating the activities, we will discuss aspects of learning that may be enhanced, such as student recall, student interest, and connection-making from abstract to concrete.

CP1.5 **Jacob Honeycutt** (honeycutt@tennessee.edu). *Infinity and Beyond: Teaching Infinity to Non-STEM Majors*
Additional authors (if any):

"Infinity and beyond" can be for "math majors and beyond." Non-math majors in a general education mathematics course can also grapple with the seemingly paradoxical qualities of infinite sets. One-to-one correspondences, countability of infinite sets, Hilbert's Hotel, and Cantor's diagonalization argument can be explained through familiar ideas and reasoning that is accessible to all students. In this talk, we will discuss the benefits of introducing these ideas in early math classes and not reserving these concepts until post-calculus. Putting a focus on the parts of mathematics which we find interesting can lead to students discovering something they enjoy as well. To this end, we embrace the unintuitive nature of infinity that is so interesting to many mathematicians. We believe that thinking about infinity teaches students to question their previously held intuitions; as Cantor said, "In mathematics, the art of proposing a question must be held of higher value than solving it." In this talk, we will (a) show how first-year non-STEM majors can learn to think about infinity, (b) share reasons why we include discussions of infinity in a general education math for liberal arts course, and (c) discuss affordances and constraints we have observed in students' understanding of the concepts.

CP1.6 **Robin Lovgren** (robin.lovgren@belmont.edu). *Assessing Multi-Section Courses â€“ First Steps*
Additional authors (if any):

Multi-section classes provide students with options for the time the class is offered as well as a choice in instructor while meeting common curricular objectives. How much is common between the classes and how do you assess course objectives across the sections? A discussion and sample of common elements and assessments will be given as well as the initial phases of implementation for a new assessment plan. Instructor meeting agenda items will also be discussed.

CP1.7 **Jonathan Clark** (jclar121@vols.utk.edu). *Deficits, Descartes, and Discovery: An Observational Approach to Teaching Curvature*
Additional authors (if any): Dr. Jeneva Clark, University of Tennessee, Knoxville

Traditionally viewed as an advanced topic, differential geometry can be taught non-math majors in a way that is both appropriate and novel. Following Descartes' theorem for the angular deficits of polyhedra, we define the curvature of a surface qualitatively as a deviation from Euclid's parallel postulate, which can be experimentally observed by drawing geodesic triangles using the ribbon test. This definition can be made quantitative by treating the curvature as a measure and studying vertex singularities. The Gauss-Bonnet theorem then generalizes and allows students to connect curvature to the Euler characteristic of the surface. In this talk, we will discuss the theoretical perspectives

underlying this viewpoint, present lesson plans implementing it, and mention its role in a textbook written by the presenters.

CP1.8 **Margaret Adams** (margaret.adams@sgsc.edu). *Extending the Concepts of Domain and Range to a Hexagon*
Additional authors (if any):

In spite of domain and range being introduced around 8th grade, the task of finding the domain and range of a function remains challenging for college students. After some initial review of domain and range of various functions and graphs, students enrolled in college algebra, pre-calculus and calculus were provided with a novel task. They were asked to find the domain and range of a hexagon with a total perimeter of 60 inches. The purpose was to explore the ability to abstract input and output properties of the domain/range concepts and extend them into an unfamiliar, non-traditional task. Most students were perplexed and did not knowing how to begin. The hexagon was often sketched in the first quadrant of the graph rather than sketched in terms of input and output. Findings suggested that students copy the figure's image to the graph without cognitively abstracting the underlying properties into the context of functions.

CP2.1 **Francis Adams** (fadams@piedmont.edu). *Descriptive Set Theory as a Second Course in Undergraduate Real Analysis*
Additional authors (if any):

Lebesgue Measure and Integration is a popular choice for a second undergraduate course in real analysis, or to be introduced as a final topic in a first analysis course. In this talk I would like to present a different collection of ideas and results that could fill this role, coming from descriptive set theory. Descriptive set theory is the study of definable sets and functions, with an emphasis on different measures of complexity. This area typically uses methods from set theory and mathematical logic to study objects of analysis. However, there are many results which fall under the heading of descriptive set theory that fit very well in a first or second analysis class where no background in set theory is expected. I hope to provide material naturally following a discussion of basic topology of the reals and continuity of real functions which may serve as isolated interesting examples, advanced topics, or student projects.

CP2.2 **Chad Awtrey** (cawtrey@elon.edu). *Field extensions defined by $x^6 + ax^3 + b$ and their Galois groups*
Additional authors (if any): Jim Beuerle (Elon University), Hanna Noelle Griesbach (Elon University)

Suppose F is a field of characteristic 0 and let $F[x]$ denote its polynomial ring. For an irreducible polynomial $g(x) \in F[x]$ of degree 6, we determine when there exists an irreducible polynomial $f(x) = x^6 + ax^3 + b \in F[x]$ such that f and g define isomorphic field extensions. As an application, we give a simple method to determine the Galois group of f.

CP2.3 **William Cook** (cookwj@appstate.edu). *Fuchs' Problem for Small Groups*
Additional authors (if any): Lindsey Wise (Appalachian State University) and Joshua Carr (Wilkes Community College)

Every ring with identity has an associated group of units. Fuchs' problem seeks to determine which group structures can appear as groups of units. The answer to this question is surprisingly messy even for nice classes of groups like cyclic groups. In this talk, we will discuss Fuchs' problem in general and then focus on groups of order 15 or less.

CP2.4 **Nancy Matar** (nmatar@wcu.edu). *Introduction to Signed Graphs*
Additional authors (if any):

Given a simple graph G=(V,E), a sign pattern of G is a function f: E -> {1,-1}. We denote a signed graph as (G,f). In this talk, signed graphs will be presented along with some properties. In addition, some results of the minimum semidefinite rank of signed graphs will be mentioned.

CP2.5 **Sarah Holliday** (shollid4@kennesaw.edu). *Distinct Representatives in Special Set Families in Graphs*
Additional authors (if any): Pete Johnson, Auburn, Steve Hedetnieimi, Clemson

In 2017, Hedetniemi asked the question “for which graphs G does the indexed family {NG(v)|V in V(G)} of open neighborhoods have a system of distinct representatives?” In 2018, 2019, and in 2020, we answered that question, and explored necessary conditions and associated parameters. Now, we move on to other special set families in graphs and examine whether they do or do not have a system of distinct representatives.

CP2.6 **Bunge, Ryan C.** (asquir00@leeu.edu). *On Tight 9-Cycle Decompositions of Complete 3-Uniform Hypergraphs*
Additional authors (if any): Brian D. Darrow: Columbia University, Saad I. El-Zanati: Illinois State University, Kimberly P. Hadaway: Williams College, Megan K. Pryor: North Carolina State University, Alexander J. Romer: Millikin University, Alexandra L. Squires: Lee University, Anna

The complete 3-uniform hypergraph of order v has a set V of size v as its vertex set and the set of all 3-element subsets of V as its edge set. A tight 9-cycle in such a hypergraph has vertex set {v_1, v_2, v_3, v_4, v_5, v_6, v_7, v_8, v_9} and edge set { {v_1,v_2,v_3}, {v_2,v_3,v_4}, {v_3,v_4,v_5}, {v_4,v_5,v_6}, {v_5,v_6,v_7}, {v_6,v_7,v_8}, {v_7,v_8,v_9}, {v_8,v_9,v_1}, {v_9,v_1,v_2} }. A decomposition of a hypergraph H is a collection of subgraphs whose edge sets partition the edge set of H. We give necessary and sufficient conditions for the existence of a decomposition of the complete 3-uniform hypergraph of order v into isomorphic copies of a tight 9-cycle.

CP3.1 **Karen Briggs** (karen.briggs@ung.edu). *When Additive and Multiplicative Inverses are the Same*
Additional authors (if any): Caylee Spivey, University of North Georgia, Undergraduate Student

Considering the ring of integers modulo n, we explore the situations in which units of the ring have the same multiplicative and additive inverses. It turns out that such a pair exists only when the modulus $n = p_1^{r_1} p_2^{r_2} \cdots p_k^{r_k}$ or $n = 2 \cdot p_1^{r_1} p_2^{r_2} \cdots p_k^{r_k}$ where for each $1 \leq i \leq k$, p_i is a Pythagorean prime and r_i is a positive integer. Furthermore, for such a modulus, we find that there are exactly 2^{k-1} pairs of elements that are both additive and multiplicative inverses of one another. We will characterize such elements and demonstrate how such elements can be constructed.

CP3.2 **Dan Scofield** (daniel.scofield@fmarion.edu). *Extremal Khovanov homology and the girth of a knot*
Additional authors (if any): Radmila Sazdanovic (North Carolina State University)

The maximal girth among the all-A graphs of a link L determines certain gradings in which the Khovanov homology of L is trivial. We describe these gradings and obtain a simple characterization of extreme Khovanov homology groups and the associated extreme coefficients of the Jones polynomial. Defining the girth of L to be the maximal girth of its all-A graphs, we describe possible values for this invariant and show that if L has an all-A graph whose girth is equal to $\ell > 2$, then the girth of L is equal to ℓ.

CP3.3 **Christian Millichap** (christian.millichap@furman.edu). *Understanding knots and links via the topology and geometry of their complements*
Additional authors (if any): Jeffrey Meyer (California State University, San Bernardino) and Rolland Trapp (California State University, San Bernardino)

Topologists often try to study a knot or link in three-dimensional space by examining its complement, i.e., the space surrounding that knot or link. How useful is this approach? Can two different knots (links) have the same complement? Interestingly enough, the answer to the second question depends on whether you consider a knot or a link with more than one component! In this talk, we will give an overview of the deep connections between knots and links and their respective complements. In particular, we will highlight how the (often hyperbolic) geometry of a knot or link complement can be leveraged as a powerful tool for analyzing knots and links.

CP3.4 **Gladden, Debra Mimbs** (asquir00@leeu.edu). *An Analysis of Melzak's Conjecture in Taxicab Space*
Additional authors (if any): Lee University: William Fulford, Samuel D. Gruber, Alexandra L. Squires

Abstract. An open optimization problem is minimizing a polyhedron's total edge length with respect to its volume. Melzak conjectured that the polyhedron with the smallest total edge length for a given volume is the equilateral triangular prism. However, Melzak only examined this problem in Euclidean geometry. This paper extends the analysis of total edge length to the Non-Euclidean metric known as Taxicab Geometry. We analyze the total edge length of multiple polyhedra in Taxicab space. Our

primary method of calculation is through Lagrange multipliers. We find that the triangular prism is not the edge-length minimizer in Taxicab Geometry and posit that the cube is the total edge length minimizer in this space.

CP3.5 **Ivan Dungan** (ivan.dungan@fmarion.edu). *Improving Topological Intuition by Exploiting Finite Spaces*
Additional authors (if any):

Topology is considered by many students a very difficult math course due to its abstractness and lack of intuition. We argue that this is more likely an artifact of focusing on spaces with complex topologies which can be overwhelming for a newcomer. We will show how following the standard approach for teaching topology, but exploiting the simplest spaces gives deep intuition behind the subject resulting in a better understanding and appreciation for it. We will end with some anecdotal evidence that students may be better prepared for more advanced topics like algebraic topology.

CP3.6 **Jason Schmurr** (jschmurr@leeuniversity.edu). *Counting Intersections of Polygons*
Additional authors (if any): Jaime Lynne McCartney, Dalton State College

What is the maximum number of proper intersections between an n-gon and an m-gon? This simply stated problem is still open in general. We discuss previous progress on the question, prove a new and improved bound, and suggest a possible path to a complete solution.

CP3.7 **Dr. Richard Moy** (mmabe000@leeu.edu). *Dessins d'Enfant and Rational Billiards Surfaces*
Additional authors (if any): Dr. Jason Schmurr- Lee University Faculty, Madison Mabe- Lee University Undergraduate Student, and Japheth Varlack- Lee University Undergraduate Student

A rational billiards surface is the surface of three-dimensional shape that allows one to view the path of a billiards ball as a continuous path instead of a jagged path obtained from numerous bounces off the sides of a billiards table. Throughout the scope of this project, we investigated triangular rational billiard surfaces and their corresponding monodromy groups. These monodromy groups are permutation groups that map the dessin d'enfant from a sphere onto another sphere or a torus. The elements of these monodromy groups are generated by <sigma_0, sigma_1>, where sigma_0 permutes the closed vertices and sigma_1 permutes the open vertices of the Cayley Graph. At the conclusion of our research, we found a way to describe the structure of these monodromy groups as a product of cyclic groups.

CP3.8 **Leina Wu** (wul@queens.edu). *Investigation of a numerical approach in solving geological problems*
Additional authors (if any): Tsun-Zee Mai, Sichuan University Pittsburgh Institute, Sichuan University, Chengdu, Sichuan, China

A revised numerical approach with Grid Refinement Method has been developed to solve linear systems generated from partial differential equations. Simulation of a geological problem by using the Grid Refinement Method along with iterative methods is presented in the paper. Accuracy and

efficiency of the Grid Refinement Method is investigated for comparison with the solutions obtained by uniform grid theme.

CP4.1 **Fabian Salinas** (FSalinas@pike.com). *Embedding K-Dimensional Grid Graphs in Orientable Surfaces*
Additional authors (if any): Christian Millichap - Furman University

A K-dimensional grid graph is the graph cartesian product of K paths. It is often the case that problems expressed in K-dimensions can be reduced to a fundamental problem in 3-dimensions. In this talk, we examine how determining the genus of a broad class of 3-dimensional grid graphs leads to determining the genus of many K-dimensional grid graphs. Our approach involves combinatorial arguments, combined with a visually intuitive method of constructing surfaces by gluing unit cubes in $\mathbb{R}^3$.

CP4.2 **Tricia Phillips** (tmphilli@bsc.edu). *A Data-Driven Mathematical Model of the Heroin and Fentanyl Epidemic in Tennessee*
Additional authors (if any): Suzanne Lenhart (University of Tennessee, Knoxville) and W. Christopher Strickland (University of Tennessee, Knoxville)

A report will be given on the formulation and analysis of a heroin/fentanyl epidemic model. This model, consisting of a system of ordinary differential equations, aims to better understand the dynamics between regular prescription opioid use, opioid addictive use, heroin/fentanyl use, and recovery from opioid addiction.

CP4.3 **Stephen Carden** (scarden@georgiasouthern.edu). *Exploration Using Without-Replacement Sampling of Actions is Sometimes Inferior*
Additional authors (if any): S. Dalton Walker, Air Force Material Command

In many statistical and machine learning applications, without-replacement sampling is considered superior to with-replacement sampling. In some cases, this has been proven, and in others the heuristic is so intuitively attractive that it is taken for granted. In reinforcement learning, many count-based exploration strategies are justified by reliance on the aforementioned heuristic. This paper will detail the non-intuitive discovery that when measuring the goodness of an exploration strategy by the stochastic shortest path to a goal state, there is a class of processes for which an action selection strategy based on without-replacement sampling of actions can be worse than with-replacement sampling. Specifically, the expected time until a specified goal state is first reached can be provably larger under without-replacement sampling. Numerical experiments describe the frequency and severity of this inferiority

CP4.4 **Mahmoud Aldeni** (maldeni@wcu.edu). *An Introduction to Market Basket Analysis-Association Rules*
Additional authors (if any):

Market basket analysis is a data mining technique used by retailers to increase sales by better understanding customer purchasing patterns. It involves analyzing large data sets, such as purchase

history, to reveal product groupings, as well as products that are likely to be purchased together. In this talk, we will discuss some algorithms associated with market basket analysis and how it works.

CP4.5 **Maggie Habeeb** (habeeb@calu.edu). *A Simple Non-commutative Oblivious Transfer*
Additional authors (if any):

In an oblivious transfer, which was first introduced by Rabin, the sender has a pair of messages and the receiver receives one of them. The sender does not know which message was received, and the receiver obtains exactly one of the messages. We will present some ideas on oblivious transfer protocols using conjugation.

CP4.6 **Grace Stadnyk** (grace.stadnyk@furman.edu). *A Recursive Formulation of Poset CC-Shellability*
Additional authors (if any): Patricia Hersh (University of Oregon)

Lexicographic shellability is a method for proving a poset is shellable and thus that the poset's order complex is shellable. Bjorner and Wachs introduced the notion of recursive atom orderings, which are now widely used as a way to prove a poset is CL-shellable, one of several flavors of lexicographic shellability. Inspired by Bjorner and Wachs' formulation of recursive atom orderings, I will introduce a recursive formulation of CC-shellability, a seemingly more general version of lexicographic shellability than CL-shellability. I will then discuss some of the insights offered by this formulation, including the surprising result that a poset is a CL-shellable poset if and only if it is a CC-shellable poset.

Undergraduate Papers Session

UT.1 **Hannah Reavis** (hannah.reavis@mga.edu). *A Brief Survey of List-Edge-Critical Graphs*
Additional authors (if any): Dr. Joshua Harrelson, Middle Georgia State University

For a graph G and nonnegative integer k, we say G is a k-list-edge-critical graph if $\chi'_\ell(G) > k$, but $\chi'_\ell(G - e) \leq k$ for all $e \in E(G)$. We survey a few known lemmas for $(\Delta + 1)$-list-edge-critical graphs and show how these lemmas achieve $\chi'_\ell(G) \leq \Delta + 1$ for certain families of G.

UT.2 **Aaron Fannin** (afannin@citadel.edu). *Prime Progressions*
Additional authors (if any):

In this presentation we will showcase our findings for the question: "How many primes does the progression $ap_n + b$ contain where p_n is the n-th prime and $\gcd(a, b) = 1$?"
We used codes in Mathematica to collect the data and best fit models for said data. Our data will be based on the question, using specific numbers for a and b which meet the standard of the greatest common divisor. For example, we will consider progressions of the form $3p_n + 7k$ such that $\gcd(3, 7k) = 1$ and $3p_n + 5k$ such that $\gcd(3, 5k) = 1$.

UT.3 **Stanley Miller** (stanleyjmiller1@gmail.com). *Neural Networks and Their Applications in Sports*
Additional authors (if any): Dr. Schmurr, professor

The sports industry uses neural networks extensively to assist in making strategic coaching decisions and to track player performance. They are growing in popularity because they have proven their efficient design. Neural networks can do the calculations for you and can easily adapt to game trends and new data. Classical probability concepts like Blaise Pascal's betting formulas and frequency methods do not provide such ease, adaptation, or accuracy when national sports like football are in play. To give an example of how neural networks can apply to multivariate games, I built a model for Candyland. I described an effective way a model can be tested for accuracy This example is only the surface of neural networks' capabilities. Sports analysts use them to predict football player performance, determine baseball matchups, recommend soccer defense plays, and advise athletic performance improvements.

UT.4 **Christian Payne** (payneca1@appstate.edu). *Generalizations of Leibniz and Lie algebras*
Additional authors (if any):

Generally, Lie algebras are vector spaces equipped with an alternating, bilinear product that obey the Jacobi identity, a sort of product rule. We will first explore Leibniz algebras, generalizations of Lie algebras in which the bilinear product is no longer required to be alternating. Then, we will extend our discussion to n-ary operations and see what connections we can make to n-Leibniz and n-Lie algebras.

UT.5 **Meagan Hodge** (mhodge4@spelman.edu). *Counting Linear Chord Diagrams that Avoid Chords of Length One*
Additional authors (if any): Dr.Naiomi Cameron; Spelman College

This presentation highlights research on linear chord diagrams. A linear chord diagram consists of $2n$ points labeled $1,2,\ldots,2n$ and n edges called chords where each chord (i,j) contains exactly two points. We consider linear chord diagrams in which every chord (i,j), where $i<j$, has length $j-i$ of at least two. We refer to chords of length two as short chords. The data on the number of diagrams with k short chords is inserted into a matrix and the goal is to determine a recursive formula or generating function for the entries. To do this we write a program to generate the information needed and investigate whether the matrix qualifies as a Riordan Array.

UT.6 **Gabriel Loos** (gl03708@georgiasouthern.edu). *Enumerating Cyclic Compositions and Their Parts*
Additional authors (if any):

Integer compositions are ordered sequences of positive integers that sum up to a given integer. We use generating functions to study cyclic versions of compositions, colored compositions under various constraints. First, a general construction of the generating functions for cyclic compositions (or their parts) is established. With this generating function we look to find and justify patterns from the number of cyclic compositions or number of parts in the cyclic compositions.

UT.7 **Hanna Noelle Griesbach** (hgriesbach@elon.edu). *When is a Polynomial Isomorphic to an Even Polynomial?*
Additional authors (if any): Dr. Chad Awtrey (faculty), Dr. Jim Beuerle (faculty)

Let $\mathbb{Q}[x]$ be the polynomial ring over the rational numbers, and let $f, g \in \mathbb{Q}[x]$ be two irreducible polynomials of the same degree. Call f and g isomorphic if there exists $h \in \mathbb{Q}[x]$ such that $f(h(x))$ is a multiple of $g(x)$. Equivalently, f and g are isomorphic if the respective field extensions they define are isomorphic. In this talk, we answer the following: Given an arbitrary irreducible polynomial $f(x) \in \mathbb{Q}[x]$, when does there exist an irreducible polynomial $g(x^2) \in \mathbb{Q}[x]$ such that $f(x)$ and $g(x^2)$ are isomorphic, and how do we compute such a polynomial g when it is known to exist? We also show that our approach can be generalized, under certain assumptions, to the case where $g(x^2)$ is replaced by $g(x^k)$ for positive integers k.

Undergraduate Poster Session

UP.1 **Aaron Gilberto** (agilber1@citadel.edu). *An Analysis of Star Periodograms: The Lomb-Scargle Method*
Additional authors (if any):

The following project works to establish a type of efficiency metric to assess the Lomb-Scargle Method of computing a periodogram of a star's rotational frequency. This method is implemented in MATLAB. In order to determine the efficiency of Lomb-Scargle, a metric of comparison is introduced. Results show the advantages of using this new metric compared to others. Different examples are presented for cases in which this metric is effective, and for a few that it is not. The original problem of determining how well the Lomb-Scargle Method works will be addressed by using this metric on synthetic data that includes noise and multiple frequencies. Finally, the project will discuss routes of future work.

UP.2 **Amyirell Harrington** (aharrington7514@g.fmarion.edu). *Decoding COVID-19 Patient Blood Tests With Machine Learning*
Additional authors (if any):

In this project, we attempt to classify hospital patients as COVID-19 positive or negative using data from blood tests. We train a neural network on a set of anonymized patient data using different activation functions and compare the results. Our findings suggest that the average accuracy of the model is virtually identical for each choice of activation function.

UP.3 **Arun Kirk** (arun.kirk@gmail.com). *Simulating Long-Term Wealth Distribution in the United States*
Additional authors (if any): Dr. Crista Arangala (Elon University)

Increasing wealth and income disparities around the world undermine fairness, productivity, and government influence in global economies. This research project examines the long term effects of unequal wealth sharing, examining what happens when trades between unequal-earning individuals are left unregulated for extended periods of time. An agent-based simulation was created using the

language NetLogo. Results of the simulation, along with the use of Markov chains, were used to model a changing wealth distribution over a sample of 30 years. Results of the simulation and analysis suggest that wealth inequality, that is, a high percentage of total wealth concentrated among a few rich individuals, is the natural "steady state" of trades. Conclusions from this project support the claim that regulation is needed to support social and economic equality.

UP.4 **Ben Race** (benrace64@gmail.com). *A Proof Involving Balancing Numbers*
Additional authors (if any): Ernest James (The Citadel)

We solved Problem 1254 from Fibonacci Quarterly, which asked for a proof of an identity involving Balancing Numbers. We researched and utilized Binet's Formula and the derivative of the geometric series to find the solution.

UP.5 **Catherine LoGrande** (clogrande@elon.edu). *A Mathematical Model of Interspecies Behavioral Patterns*
Additional authors (if any): Dr. Crista Arangala, Chair of the Mathematics and Statistics Department at Elon University

Honeybees and zebrafish are two species which generally move and make decisions as a group within their own species. The two species have no way of interacting with one another under ordinary circumstances, however, they are capable of inter-species collective decision making with the use of robots to influence their movement. Dr. Crista Arangala and undergraduate student Catherine LoGrande demonstrate a mathematical model of the two species coming to a consensus on their decision of movement when presented with a binary decision through this research conducted at Elon University.

UP.6 **Daniel Hammer** (dlhammer2@catamount.wcu.edu). *An Exploration of Evolutionary Game Theory*
Additional authors (if any): Dr. Andrew Penland, Nicholas O'Kelley, Andrew Shelton

We are investigating the mechanics of two-player games to discover methods of generating optimal winning strategies for player 1 over various simple games. We will use evolutionary game theory to generate populations of players, pit them against each other in tournaments, and isolate winning strategies in a generational cycle until optimal strategies are identified. We have streamlined the process of generating large amounts of useful data from generalized games. We will identify similarities between winning strategies in hopes to provide insight on less-understood games, such as the two-player graph coloring game.

UP.7 **Ernest James** (ejames3@citadel.edu). *Mathematical Models of COVID-19*
Additional authors (if any): Dr. Mei Chen; The Citadel Faculty

The COVID-19 Pandemic has been felt across the world. The virus has left us with many questions regarding the effectiveness of social distancing and lockdown orders along with the growth of the virus. Our project focuses on the states of North Carolina, South Carolina, Tennessee, Georgia, and Florida from March 4th to July 20th 2020 in order to learn more about the virus. Our goal is to

determine the effectiveness of social distancing measures and lockdown orders and to predict the behavior of the Coronavirus in these five states with data reported by the COVID Tracking Project in two parts.

UP.8 **Ethan Nussio** (ethannussio@gmail.com). *Statistics and Feature engineering used to Evaluate the Effectiveness of Healthcare's Diabetes Management Program.*
Additional authors (if any):

Data analytics is a very important field within mathematics and statistics used to investigate and discover unique perspectives in various fields such as business, healthcare, and technology. A useful technique within the field of data analytics is feature engineering. Feature engineering is a tool used in data analytics that focuses on grouping predictor variables into individual groups to improve the predictive ability of statistical models. Healthcare is one such field in which feature engineering can reveal new insights. My team used data analytics and feature engineering as well as statistical theory to investigate and suggest ways to improve a local hospital system's Diabetes Management Program. By focusing on specific categories of A1C's, the standard benchmark for evaluating management of diabetes, our team discovered a unique approach to improving the effectiveness of the hospital system's diabetes management program. The A1C categories considered were very poor control, poor control, moderate control, and good control. By focusing on specific categories of A1C's, the patients' abilities to manage their diabetes through the programs differed. In fact, it was found that patients who had poor and very poor control differed significantly from the patients who had moderate and good control. Understanding the use of feature engineering and data analysis in our study can lead to improvements of other healthcare programs through a similar methodology.

UP.9 **Gabriel Loos** (gl03708@georgiasouthern.edu). *Methods for Finding Convex Partitionings of Polygonal Structures*
Additional authors (if any):

Partitioning geometric structures into convex shapes is a classic problem with many applications. It is well known that any polygon can be divided into n-2 triangles. It has also been shown that orthogonal polygons can be divided into convex quadrilaterals. These results were applied to the art gallery problem, leading to some beautiful consequences in optimization. We consider generalizations of orthogonal polygonal shapes and â€œoptimal partitionsâ€. Some observations of broad interests are established, along with some systematic approach of convex partitioning polygonal structures. In particular, we will discuss related bounds and theories for some hexagonal structures.

UP.10 **Ja'Nya Breeden** (janya.breeden@g.fmarion.edu). *At Least Squares Can Solve Fluid Flow Equations*
Additional authors (if any): Jada Lytch (Francis Marion University), Taylor Boatwright (Francis Marion University)

The Navier-Stokes equations are used to model fluid flow. Examples include fluid structure interactions in the heart, climate and weather modeling, and flow simulations in computer gaming and entertainment. The Navier-Stokes equations date back to the 1800s. Research and development of numerical approximation algorithms continue to be an active area. Using C++ and the academic software library deal.II, we have implemented a least squares finite element algorithm based on work

by Roland Glowinski and colleagues to approximate solutions to the Navier-Stokes equations. We review the Navier-Stokes equations and discuss the least squares algorithm and its implementation. Finally, we apply the least squares solver to the lid driven cavity problem and visualize results.

UP.11 **Joseph Semler** (jsemler1@my.apsu.edu). *Taylor Series solution and a related numerical technique for the Van der Pol equation*
Additional authors (if any): Samuel Jator, Ph.D., affiliation: Austin Peay State University

The Van der Pol equation has applications across multiple fields as a model for oscillating systems. In this paper, we explore an approximate analytical solution to the Van der Pol equation through the use of a Taylor Series approximation. The Taylor Series is both readily accessible and simple to use, resulting in a straightforward method for obtaining an approximate solution to the problem. Moreover, we derive a related numerical technique via the Taylor Series approach and show that the method also accurately solves the Van der Pol's equation.

UP.12 **Joycelyn Young** (jyoung74@my.apsu.edu). *Confidence Intervals and Pool Noodles*
Additional authors (if any):

Advanced high school students in statistics struggle with the idea of confidence intervals. Students need a concrete visual of their individual sample mean as it relates to a confidence interval. An abstract concept using a given mean does not help the student make sense of means that may fall outside of the confidence interval. This study aims to determine how visual representations can better target ideas in statistics, especially confidence intervals . Specifically, it investigates whether the perceived mean and sampling means are related and to what extent the confidence interval levels effect the sampling means.

To make the connection between the values obtained during sampling and confidence intervals, each student will complete a sample. The student uses the middle of their pool noodle to mark their sample mean. Each student places the mean of their pool noodle under the number line for the given data set for a confidence interval of .99, .95, and .68. The students discuss how some means are within the interval and some are not within the interval. The visual will make a long-time connection between confidence intervals and potential calculated means.

These results will help students retain the idea of confidence intervals at different levels. On this basis, the concept of visuals should be taken into account when teaching confidence levels.

UP.13 **Kenya Isller** (isller_kenya@columbusstate.edu). *Using AI to Improve Student Learning in Abstract Algebra*
Additional authors (if any): Ronald Linton, Columbus State University Math Department

In this research group, we consider developing gamer- based software that will offer mathematics majors an opportunity to better understand complex concepts in Abstract Algebra. Students will get a deeper understanding of left and right identities and zeros, noncommutativity, idempotents, sub semigroups, and subgroups with visual representatives of finite semigroups and groups.

UP.14 **Maximo Rainwater** (mrainwater8969@g.fmarion.edu). *Using machine learning to determine boardgame ratings*
Additional authors (if any):

This project aims to determine whether a textual review of a board game is positive or negative through sentiment analysis. We describe a method of One-Hot Encoding(OHE) to vectorize a data set of board game reviews by comparing the words used to a dictionary of words in the English language. We train a neural network on the vectorized data set and describe the accuracy of our classification for different parameter values.