**Presenter name: Alice Parker**

Title: The Construction of Tessellations with Linear Algebra

Abstract: Tessellations are shapes that when repeated can infinitely tile a plane. Two-dimensional tessellations can easily be manually constructed from a square piece of paper with some simple cuts and taping. This project looks at translating these physical transformations carried out on paper, to the language and operations of linear algebra. Specifically, the creation of two varieties of tessellations, translational and rotational, are examined in their relation to basis vectors, linear combinations, and matrix multiplication.This poster is adapted from a project completed for Alicia Lamarche's Math 2270: Linear Algebra class.

**Presenter Name: Eliza C. Diggins**

Title: Constructing International Trade Networks to Predict the Origin of Trade Mediated Pathogens: The Harmony Project

Abstract: The emergence of the COVID-19 pandemic and its continued prevalence in the human population has illustrated significant obstacles to infectious disease surveillance and prevention on a global scale. While a great deal of research has been done on the impact of globalization on human-human transmission of pathogens, significantly less focus has been placed on the role that the international trade of commodities might play in the spread of pathogens. Additionally, the rising threat of climate change poses significant challenges to both the stability of the global food supply, and to the resilience of staple crops against pathogens which could impact humans. To provide rapid identification of source countries and commodities for an emergent, trade-mediated pathogen, we present a computational approach which utilizes international trade data to reconstruct the underlying trade networks which could facilitate pathogen transmission. Data from the UN Comtrade database provides unparalleled accuracy and coverage with which to conduct the analysis. By utilizing network analysis techniques on individual networks and subsequently applying time series analysis to sequences of networks, correlations can be identified between changes in network topology and available epidemiological datasets, revealing potential source candidates. Using this technique, emergent pathogens in international trade can be analyzed for most probable source country and commodity, which in turn can be tested in planta for confirmation of the pathogen. Further application of the Harmony Project will focus on understanding the role of network topology in the development of epidemic behavior due to these emergent pathogens with the intention of influencing public health and safety policy on a global scale.

**Presenter Name: Emil Geisler**

Title: Representations of the Symmetric Group from Geometry

Abstract: Representation stability was introduced to study mathematical structures which stabilize when viewed from a representation theoretic framework. The instance of representation stability studied in this project is that of ordered complex configuration space, denoted PConf_n(\C):

PConf_n(\C) := { (x_1, x_2, ..., x_n) \in \C^n | x_i != x_j }

PConf_n(\C) has a natural S_n action by permuting its coordinates which gives the cohomology groups H^i(PConf_n(\C);\Q) the structure of an S_n representation. The cohomology of PConf_n(\C) stabilizes as n tends toward infinity when viewed as a family of S_n representations. From previous work, there is an explicit description for H^i(\pconf_n(\C);\Q) as a direct sum of induced representations for any i, n, but this description does not explain the behavior of families of irreducible representations as n\to\infty.

We implement an algorithm which, given a Young Tableau, computes the cohomological degrees where the corresponding family of irreducible representations appears stably as n\to\infty. Previously, these values were known for only three Young Tableaus. Using this algorithm, results have been found for all

Young Tableau with up to 8 boxes and certain Tableau with more, which has led us to conjectures based on the data collected.

**Presenter Name: Emily Erickson**

Title: Linear Programming and the Simplex Method: Introduction, Intuition, and Applications

Abstract: Developed in 1947 by George Dantzig, the simplex method for solving linear optimization problems has been one of the most impactful algorithms of our time. Through solving an operations research problem, I will introduce you to the algorithm, focusing on programmatic implementation as well as algebraic and geometric intuition for why it works. I will also discuss how linear and integer programming are being applied to great success in many fields.

**Presenter Name: Jacob Strong**

Title: Utilizing Gröbner Bases to Create Families of Polynomials with Shared Algebraic and Geometric Properties

Abstract: Algebraic geometry is a branch of mathematics which studies zeros of multivariate polynomials. In algebraic geometry, abstract algebraic techniques may be used to solve geometrical problems about these given zeros. My poster will briefly summarize mathematical rings and fields, algebraic geometry as a branch of mathematics, partitions of rings, how Gröber Bases may be used to create partitions of rings, Chinese Remainder Theorem, and ongoing research utilizing Gröbner Bases to create partitions which cover polynomial rings such that we may use Chinese Remainder Theorem and our found partitions to find infinite families of polynomials with a set of desired properties.

**Presenter Name: Molly Christensen & Violeta Vasilevska**

Title: Discovering mathematical beauty and creativity through STEM connections

Abstract: This poster presentation will highlight several aspects of the outreach program Math Girls Rock! as a way to make high level (college) math appropriate for high school female students, with the aim to excite them about math and science and encourage them to consider STEM careers. Some of the projects' topics (used during this program) will be discussed, and the intentional connections with other sciences/fields that the program projects/presentations display will be highlighted. All projects are designed to emphasize the beauty and creativity of mathematics and show students that math is for all. Furthermore, some of the feedback in survey results from the participants about these projects/program will be shared.

**Presenter Name: Pedro López-Sancha**

Title: Bernstein-Sato roots of determinantal ideals

Abstract: Bernstein-Sato theory has been a flourishing field of research in Commutative Algebra and Algebraic Geometry in recent years. An appealing fact to study is the interplay between the theories in characteristic zero and positive characteristic, as well as the classes of ideals in which they coincide. Among the key algebraic invariants in the positive characteristic setting, we find Bernstein-Sato roots and nu-invariants. In this talk we will discuss the behavior of these invariants for determinantal ideals over perfect fields of positive characteristic and the relation to characteristic zero.

**Presenter Name: Peter Wear**

Title: An introduction to p-adic numbers

Abstract: Which integers can be written as a sum of three squares? This problem is hard to approach directly, but easier if we reduce modulo a prime number p. The p-adic numbers let us move from this

easier case to the harder one. This poster will give a brief overview of how this works and how to define and work with p-adics: a world where every triangle is isosceles and the square root of 7 can be an integer.

**Presenter Name: Selvi Kara**

Title: Meet a Mathematician

Abstract: In this poster, we will introduce Math For All SLC participants to the Meet a Mathematician Project. Meet a Mathematician is a collection of short video interviews with mathematicians mostly from historically excluded backgrounds in mathematical sciences. This project's goal is to introduce students to role models and amplify the voices of mathematicians from underrepresented backgrounds.