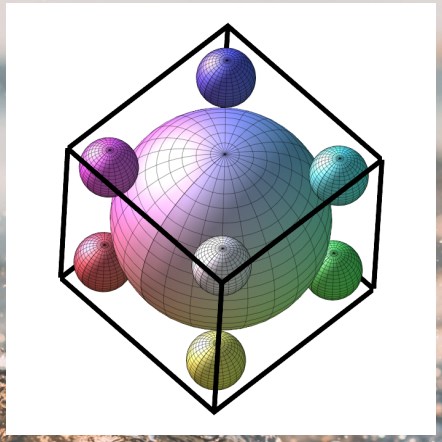
MAA MATHEMATICAL ASSOCIATION OF AMERICA | SECTION METRO NEW YORK

MAY 1, 2021



THE METROPOLITAN NEW YORK SECTION
VIRTUAL MEETING 2021

Dear MAA Metro New York Conference Participants,

It is my distinct honor to welcome you to our second Virtual Annual Meeting of the Mathematical Association of America Metropolitan New York Section (MAA Metro NY)!

We look forward to your participation in today's meeting. We have an impressive array of presentations that promises to invigorate your mathematical curiosities. I would like to express my appreciation and thanks to our MAA committee members whose diligence and hard work helped bring this meeting to fruition.

Our special thanks go out to our invited speakers, Dr. Jacqueline Jensen-Vallin and Dr. Melvyn B. Nathanson, who will share with us exciting and cutting-edge mathematics today. We would also like to thank you for attending and contributing to our meeting and invite you to become part of our vibrant MAA Metro NY community.

This year's program features eighty presentations, with over one hundred presenters that span a smorgasbord of topics which highlight research in mathematics, pedagogy and technology usage. Presenters include high school students, undergraduate and graduate researchers, mathematicians and industry professionals who hail from over thirty different institutions that are located in New York, Boston, California, Connecticut, Texas, North Carolina and the UK.

Our section website now features a problem of the month which has a growing local and international following. We also begin with the inaugural *Janet Liou-Mark Student Mathematics Award* in honor of our dearly departed section chair, Dr. Janet Liou-Mark whose work has made a lasting impact on our students and section.

Thank you for coming and we hope that you have an outstanding experience at our meeting.

With best regards,
Satyanand Singh on behalf of the MAA Metro New York Committee

WELCOME

MATHEMATICAL ASSOCIATION OF AMERICA

MAA METRO NEW YORK CONFERENCE ORGANIZERS

Armen Baderian, Nadia Benakli, Johanna Franklin, Benjamin Gaines, Elena Goloubeva, Ezra Halleck, Xiaomeng (Vivian) Kong, Nadia Kennedy, Boyan Kostadinov, Joseph Lindquist, Abraham Mantell, Ariane Masuda, Eric Rowland, David Seppala-Holtzman, Satyanand Singh (Chair), Mutiara Sondjaja, and Johann Thiel

CONTRIBUTED PAPER AND POSTER SESSIONS ORGANIZING COMMITTEE

Boyan Kostadinov (Chair), Ezra Halleck, and Johann Thiel

PROGRAM COVER DEPICTS SPHERES SITTING IN A CUBE

The spheres sitting in a cube is a "Problem of the month" created by Dr. David Seppala-Holtzman.

Explore the monthly problems by following the link below.

http://sections.maa.org/metrony/problemofthemonth.html

THE MAA ANNUAL MEETING OF THE METROPOLITAN NEW YORK SECTION

MAY 1ST, 2021

AGENDA

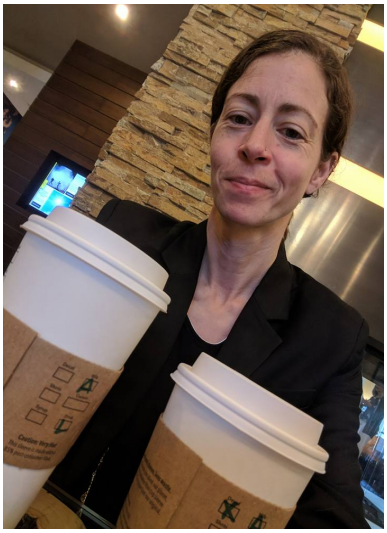
8:45-8:55 AM	Welcome Dr. Satyanand Singh *Chair of the Metropolitan New York Section of the MAA, New York City College of Technology, CUNY*
9:00-9:45 AM	Invited Speaker: Dr. Jacqueline Jensen-Vallin *Lamar University & Editor of MAA Focus*
10:00-10:45 AM	Invited Speaker: Dr. Melvyn B. Nathanson *Lehman College & CUNY Graduate Center*
11:05-11:15 AM	Break
11:20-12:35 PM	Contributed Paper Sessions I Research Session: Applied Mathematics I (Presider: Dr. Ariane Masuda) Research Session: Pure Mathematics I (Presider: Dr. Ezra Halleck) Research Session: Data Science and Miscellaneous (Presider: Dr. Boyan Kostadinov) Pedagogy Session: Mathematics Education I (Presider: Dr. Nadia Benakli) Student/Faculty Session I (Presider: Dr. Eric Rowland)
12:40-1:25 PM	Lunch Break/Contributed Poster Session (Supervisor: Dr. Johanna Franklin)
1:30-3:00 PM	Contributed Paper Sessions II Research Session: Applied Mathematics II (Presider: Dr. Boyan Kostadinov) Research Session: Pure Mathematics II (Presider: Dr. Johann Thiel) Pedagogy Session: Mathematics Education II (Presider: Dr. Nadia Kennedy) Student/Faculty Session II (Presider: Dr. Benjamin Gaines)
3:05-3:20 PM	Metro NExT Meeting Dr. Benjamin Gaines, *Iona College* Dr. Tia (Mutiara) Sondjaja, *New York University* Dr. Johann Thiel, *New York City College of Technology, CUNY*
3:25-4:15PM	Business Meeting (Presider: Dr. Satyanand Singh)

INVITED SPEAKERS

Dr. Jacqueline Jensen-Vallin, Lamar University & Editor of MAA Focus

Title: Let's Get Knotty

Abstract: My early interest in numbers and patterns lead me down a (nonlinear) path to mathematics, which has led me to the twisty world of knots. Mathematically, knots are non-intersecting closed curves in space. We will use sequences and patterns to explore this world and play with a classic question in knot theory - given a knot diagram, how do I identify the knot? There will be plenty of examples, conjectures, and fun.



Bio: After earning her PhD in low-dimensional topology from the University of Oregon in 2002, Jacqueline Jensen-Vallin joined the faculty at Sam Houston State University in Huntsville, TX, where she received tenure and promotion to Associate Professor in 2008. She spent four years at Slippery Rock University in Slippery Rock, PA, and is now at Lamar University in Beaumont, TX. While at SHSU, she founded the Texas Undergraduate Mathematics Conference (which has now become a regional meeting at a rotating venue, drawing more than 100 students from Texas and Louisiana Annually) and the Piney Woods Lecture Series. She has successfully engaged undergraduate students in research; involved students in the larger mathematical community by taking them to local, Pi Mu Epsilon Councillor; and served on the regional, and national conferences; has served as a Mathematical Association of America Committee on Undergraduate Student Activities and Chapters and on the MAA Committee on Sections. She is currently the editor of MAA FOCUS, the newsmagazine of the MAA. In addition to her mathematical career, she is a knitter (and sometimes crochet-er), and a mother of twins.

INVITED SPEAKERS

Dr. Melvyn B. Nathanson, Lehman College and CUNY Graduate Center

Title: Problems and results on Sidon sets

Abstract: A Sidon set is a set A of positive integers with the property that no integer has more than one representation as the sum of two elements of the set. Thus, if $a, b, c, d \in A$ and $a + b = c + d$, then $\{a, b\} = \{c, d\}$.
The investigation of Sidon sets is one of the oldest topics in combinatorial number theory, with many results and many more unsolved problems. In the past year, some open problems have been solved, and new areas of research have begun. This talk will survey these new developments in the theory of Sidon sets.

Bio: Melvyn Bernard Nathanson (born October 10, 1944, in Philadelphia, Pennsylvania) is an American mathematician, specializing in number theory, and a Professor of Mathematics at Lehman College and The Graduate Center (City University of New York). His principal work is in additive and combinatorial number theory. He is the author of over 200 research papers in mathematics, and author or editor of 25 books.

More information can be found on Wikipedia (https://en.wikipedia.org/wiki/Melvyn_B._Nathanson) and at www.theoryofnumbers.com/melnathanson

METRO NExT (NEW EXPERIENCES IN TEACHING)
3:05 PM – 3:20 PM

Metro NExT (New Experiences in Teaching) is a local version of MAA's Project NExT, a professional development program for new or recent PhDs in mathematics. Our goal is to build a community of new faculty and graduate students in the NY Metro MAA Section to help each other develop effective strategies for all aspects of our professional lives from teaching to research to service.

In this presentation we will give a brief overview of past, present, and future activities at Metro NExT. Join us and find out how you can get involved!

Organizers: Dr. Benjamin Gaines, *Iona College*
Dr. Tia (Mutiara) Sondjaja, *New York University*
Dr. Johann Thiel, *New York City College of Technology*

CONTRIBUTED PAPER SESSIONS I

11:20 AM – 12:35 PM

RESEARCH SESSION: APPLIED MATHEMATICS 1

Presider: Ariane Masuda

11:20 a.m. **Computing the fourth term of Nathanson's $\lambda_{2,3}(h)$ sequence.**
Satyanand Singh, New York City College of Technology, CUNY

We consider the sets:

$A_n = \cup_{j=0}^{\infty}\{\varepsilon_j(n)\cdot n^j : \varepsilon_j(n) \in \{0, \pm 1, \pm 2, ..., \pm\lfloor n/2\rfloor\}\}.$

Let $S_{\{2,3\}} = A_2 \cup A_3$. We denote $\lambda_{2,3}(h)$ to be the smallest positive integer that can be represented as a sum of h and no less than h elements in $S_{\{2,3\}}$. Nathanson studied the properties of the $\lambda_{2,3}(h)$ sequence and posed the problem of finding the values of $\lambda_{2,3}(h)$ for $h \geq 4$, which are very important in geometric group theory and additive number-theory. In this presentation, we will illustrate how to generate $\lambda_{2,3}(4)$. This is the fourth term of the sequence A306589 in OEIS.

11:35 a.m. **A conjugate directions-type procedure for quadratic multiobjective optimization**
Ariane Masuda, New York City College of Technology, CUNY

We propose an extension of the real-valued conjugate directions method for unconstrained quadratic multiobjective problems. When it is implemented with a weakly-increasing (strongly-increasing) auxiliary function, the scheme produces weak Pareto (Pareto) optima in finitely many iterations. This is joint work with E. H. Fukuda and L. M. Graña Drummond.

11:50 a.m. **Solution of the Stokes-Darcy system in three dimensions**
Svetlana Tlupova, Farmingdale State College, SUNY

We present a framework for a robust and highly accurate numerical solution of the coupled Stokes-Darcy system in three dimensions. The method is based on (1) a Dirichlet-Neumann type splitting of the interface conditions and solving separate Stokes and Darcy problems iteratively, and (2) second kind boundary integral equations for the local problems. The integral equations use a smoothing of the kernels that achieves high accuracy on the boundary. We present numerical results for a benchmark problem of viscous flow around a porous sphere, as well as more general surfaces.

12:05 p.m. **A Numerical Investigation of the Wilson-Cowan Model**
Maxwell Bohling, Andrew Cirincione, Manhattan College
Advisor: Lawrence C. Udeigwe

In the present project, we investigate various numerical properties of the Wilson-Cowan model. This model describes the dynamics between excitatory and inhibitory subpopulations of neurons from a macroscopic perspective. We investigate the stability of this model under the ReLU and shifted logistic sigmoid activation functions, obtain parametric regimes that guarantee certain stability behaviors (including stable and oscillatory steady states), and explore possible biological implications of our results. Lastly, we use the BCM rule to vary the synaptic weights (with time) between the subpopulations in the Wilson-Cowan model. Our preliminary results suggest that introducing the BCM rule does not change the types of steady states we observe in the absence of the BCM rule, however, the previously established parametric regimes may no longer hold.

12:20 p.m. **From Primitive to Predictive: The Importance of Numerical Weather Forecasting**

Breanna Biancardi, Molloy College
Advisor: Deborah Upton

In the 20th century, the thought of applying mathematical models to predict the weather was developed, known as numerical weather prediction. Since then and the dawn of computers, mathematics has played a very important role in weather forecasting. This presentation will illustrate two applications of mathematics used to predict the weather, the finite difference method and the spectral method. These techniques are used to approximate the solutions of differential equations. Primitive equations are the nonlinear differential equations that are fundamental to describing atmospheric processes. The goal is to bring attention to an application of mathematics that is not often taught but still within the understanding of an undergraduate mathematics major.

RESEARCH SESSION: PURE MATHEMATICS 1

Presider: Ezra Halleck

11:20 a.m. **Almost Isometric Embeddings of Riemannian Manifolds with Heat Kernels of the Connection Laplacian**

Esteban Alcantara, Maziar Farahzad, Chen-Yun Lin, Julinda Pillati, Christina Sormani, Lehman College, CUNY

Data collected for the purpose of machine learning is often in a high-dimensional space, but yet is believed to satisfy certain low dimensional structure, that is, the collected dataset can be well approximated by a low dimensional manifold sitting inside a high dimensional Euclidean space. How to analyze a dataset under this assumption is generally called the manifold learning problem. One particular goal is to recover the nonlinear low dimensional structure of the manifold and to reduce the dimensionality of the space where the dataset lies inside. Mathematically, this problem is formulated as asking if it is possible to have an embedding to put the manifold (hence the dataset) into a finite dimensional Euclidean space that is bi-Lipschitz, even isometric. We show that any closed n-dimensional manifold (M, g) can be embedded by a map constructed using the heat kernels of the connection Laplacian as well as a maps constructed using truncated heat kernel at a certain time t from a delta-net via a rescaling trick. Both the time t and the size of the delta-net are bounded in terms of the dimension, bounds on the Ricci curvature and its derivative, the injectivity radius, and the volume. Moreover, both maps can be made arbitrarily close to an isometry.

11:35 a.m. **Using quaternions to prove theorems in spherical geometry**

Marshall Whittlesey, California State University San Marcos

It is well known that the complex numbers can be used to do transformation geometry in the plane. It is less well known that the quaternion algebra (consisting of expressions of the form a+bi+cj+dk where i,j, and k are square roots of -1) can be used to do similar transformations in three dimensional space. In this talk we show how to use quaternions to prove an interesting classical theorem 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.

11:50 a.m. **On a reciprocity formula for inhomogeneous generalized Dedekind-Rademacher sums**

Brad Isaacson, New York City College of Technology, CUNY

It is well known that the classical Dedekind sum was introduced in connection with the transformation formula of the logarithm of the Dedekind eta function from which Dedekind was able to deduce his famous reciprocity formula. There are many functions possessing transformation formulae similar to that of Dedekind's eta function. Appearing in these transformation formulae are various generalizations of Dedekind sums involving Bernoulli polynomials and these generalizations satisfy similar reciprocity laws. In this talk, we consider one such generalization and prove its corresponding reciprocity formula which contains all of the reciprocity formulas in the literature for inhomogeneous generalized Dedekind-Rademacher sums as special cases.

12:05 p.m. **The Isomorphism Problem for Monomial Digraphs**

Alex Kodess, Farmingdale State College

Let p be a prime, let e be a positive integer, q = p^e, and let Fq denote the finite field of q elements. Let m, n, 1 <= m,n <= q-1, be integers. The monomial digraph D = D(q; m,n) is defined as follows: the vertex set of D is Fq^2, and ((x1,x2),(y1,y2)) is an arc in D if x2 + y2 = x1^m y1^n. We study the question of isomorphism of monomial digraphs D(q; m1, n1) and D(q; m_2, n_2). We conjecture that D(q; m1,n1) is isomorphic D(q; m2,n2) if and only if (m2,n2) = k(m1,n1) for some integer k coprime with q-1. While the sufficiency of this condition is known, its necessity remains an open question. We present a number of partial results that support the conjecture.

12:20 p.m. What is the Collatz Conjecture and why is it so interesting?

Alexander Atwood and Russell Coe, Suffolk County Community College, SUNY

Proposed by Lothar Collatz in the 1930's, the Collatz Conjecture is one of the most difficult open problems in mathematics. We will describe the conjecture, demonstrate how it works, talk about why proving it is so difficult, and describe recent significant work on this subject.

RESEARCH SESSION: DATA SCIENCE & MISCELLANEOUS

Presider: Boyan Kostadinov

11:20 a.m. **Extending ggplot2 statistical geometries**

Evangeline Reynolds, United States Military Academy, West Point

Ggplot2, the implementation of the grammar of graphics in the R statistical programming language, is a popular open source project. Because it provides an interface that lets creators separate data visualization concerns, including declaration of data, variable representations by visual channels, determination of coordinate systems, selection of geometric shapes taking on the aesthetic representation, users have great freedom in the creation and customization of charts. Ggplot2 comes with a large number of geometric shapes that can represent variables in data sets. Some of these shapes are drawn after statistical transformation, such as boxplots, linear regressions, or histograms. But many statistical concepts do not have easy-to-use geometries for representing statistical summaries. This paper presents a new extension package "ggxmean", that include new "geoms" useful for easily visualizing an important set of additional statistical concepts.

11:35 a.m. **Edge detection and convolutional neural networks**

Xiaona Zhou, New York City College of Technology, CUNY
Advisor: Boyan Kostadinov, New York City College of Technology, CUNY

We studied how edge detection could be done with convolutional operation. We rewrote the algorithm from scratch in R and compared edge images resulting from different filters, such as Sobel filter and Scharr filter. For a better edge detection outcome, we studied the five steps procedure in Canny Edge Detection in detail and rewrote the code from scratch in R again. We also learned about convolutional neural networks and implement some of its applications, such as car detection and face recognition

11:50 a.m. **Kolmogorov-Smirnoff Statistic and Kullback-Leibler Divergence Reliability Discrimination**

Mario Andriulli, James Starling, Blake Schwartz, United States Military Academy

This presentation evaluates the impact of incorrectly choosing a probability distribution when modeling lifetime data in logistic and reliability applications. A probability of correct selection is estimated from a Monte Carlo simulation, assuming the lifetime data are sampled from Weibull, gamma, and log-normal probability distributions. We compare the results using the Kolmogorov-Smirnoff distance and the Kullback-Leibler divergence metrics to determine the impact of an incorrect selection, dependent upon sample size. The results will provide valuable insights into the distribution selection in reliability and logistic applications.

12:05 p.m. **Type I Errors & the Robustness of ANOVA**

Rebecca Conley, Gerald G Gabinete, Saint Peter's University

When should you use an ANOVA and when should you use a Kruskal-Wallis test? Or, should you apply a series of two-sample tests with an adjusted significance level? Spencer, Lay, and Kevan de Lopez published a flowchart in 2017 to help researchers make these decisions. The flowchart is based on the sample statistics, and not preliminary hypothesis testing, which has been shown to be problematic in terms of the Type I errors. How does using sample statistics in the decision making process affect the probability of a Type I error? Is the probability equal to the significance level, as it should be? We use a Monte Carlo type simulation in R to empirically calculate the probability of committing a Type I when using the flowchart. We also calculate the probability of a Type I error on the same samples when using ANOVA regardless of the sample statistics. We consider a variety of different sample sizes, population distributions, and population variances. We summary our results and give recommendations to researchers.

12:20 p.m. **Using Generative Adversarial Networks for The Production of Common Core Algebra Questions**

Anthony Nosoff, Taylor Leung, Midwood High School
Advisor: Glenn Elert

Generative adversarial networks have many applications in interpreting and generating data, ranging from composing images to creating entirely new music. How can we apply generative adversarial networks (GANs) to the classroom? The goal of this study is to adapt a GAN to generate Common Core Algebra questions on-par with the material taught in the New York State Algebra I curriculum. Teachers have faced the issue of having to come up with questions on their own, and with the recent push to online learning, multiple test forms have also become a greater point of concern. We will propose a method of generating new exam questions by training a language-processing GAN model to interpret a database of existing questions and generate its own similar-style questions, alleviating the need for teachers to make their own, as well as offering more practice possibilities for students.

PEDAGOGY SESSION: MATHEMATICS EDUCATION 1

Presider: Nadia Benakli

11:20 a.m. Supporting Women in Associate Computer Science and Baccalaureate Applied Mathematics Programs

Sandie Han, Urmi Ghosh-Dastidar, Nadia Kennedy, New York City College of Technology, CUNY

This presentation focuses on recruiting and supporting female undergraduate students in an Applied Mathematics baccalaureate and a Computer Science associate degree programs and on providing evidence-validated interventions to support their retention, graduation, and workforce entry. It reports on results on the efforts in recruiting and supporting female students, which efforts were supported by a NSF S-STEM grant, and in response to a demonstrated local and national underrepresentation of women, particularly in Applied Mathematics and Computer Science.

11:35 a.m. Calculus and the Mathematics of Social Justice

Monica Morales, Adelphi University

During times of crisis we are challenged to reconsider our teaching methods and improve them with the goal of helping the maximum number of students. Mathematics has always been known as a realm to which only the privileged ones have access to it. In the last months, we, the professors/teachers have been forced to change and discard the traditional teaching math techniques that most of us thought were set on stone but that we now know are useless and harmful for the majority of the students taking our classes. In recent weeks a lot of us heard the term “Social Justice ", but we might wonder how Social Justice is linked to the well-established and known calculus curriculum. I pose some questions, how do we teach Social Justice in a Calculus class? How do we teach calculus to improve the accessibility of knowledge to the majority of students that have been marginalized by old teaching techniques? In this talk I will discuss a project-based approach to the calculus curriculum and the use of the book “Mathematics for Social Justice, Resources for the College Classroom” by G. Karaali and L. Khadjavi.

11:50 a.m. Cluster Analysis of Students' Abilities to Self-Assess Mathematical Skill

Caleb Sheffield, United States Military Academy

While teaching in the Advanced Mathematics Program (AMP) at the United States Military Academy (USMA) at West Point, a colleague and I chose to implement weekly quizzes with questions similar to some which would be seen on mid-term exams. One set of students was given the opportunity to report their quiz performance without risk to their grades, and later to express their confidence with the material prior to the exams. The other set of students reported their score to the teacher in class immediately following the quiz. The latter set is used as a control because they do not provide a measure of confidence with the quizzed/tested material. This research explores how well students assess their own abilities, whether there are groups of student types or behaviors, and whether a student’s confidence is correlated to their mid-term exam scores or overall class grade.

12:05 p.m. A journey through teaching methods and its impacts

Shamita Dutta Gupta, Pace University

In this presentation, we will discuss several teaching methodologies such as Service-Learning Courses, Writing Enhanced Courses, Learning Communities, and Online synchronous, asynchronous, mix and web-assisted courses. We will engage in a discussion of what works or doesn’t, addressing questions such as: Does a specific teaching methodology only work for a certain level of Math course? Does the mode of delivery depend on the level of Mathematics?

12:20 p.m. SIMIODE - What's in it for all?

Brian Winkel, SIMIODE

We present SIMIODE – Systemic Initiative for Modeling Investigations and Opportunities, describing inception, opportunities, resources, and student and teacher activities. We feature three engagements: (1) SCUDEM – SIMIODE challenge Using Differential Equations Modeling, (2) SIMIODE Expo – an annual online conference, and (3) SIMIODE online text, Differential Equations: A Toolbox for Modeling the World. Most importantly we introduce some exciting applications of modeling with differential equations to help teachers motivate teaching differential equations and students get real and get motivated in their studies and applications of differential equations. We offer scenarios in life sciences, physical sciences, engineering, and other fields. Modeling phenomena with data is the order of the day in SIMIODE. All resources are Open Education Resources in SIMIODE, so come and visit us at www.simiode.org. SIMIODE is currently supported by the National Science Foundation.

STUDENT/FACULTY SESSION 1

Presider: Eric Rowland

11:20 a.m. **Cooperative Relaxation in Supercooled Liquids: Kadanoff's Block Construction and Wilson's Renormalization Group Transformation**

Nadine Meister* (Harvard), Udayan Mohanty (Boston College)
Advisor: Catherine Asaro

A supercooled liquid is one that is cooled below the freezing point yet remains a liquid. A significant application of supercooled liquids is for metallic glasses, which have increased strength, elastic strain, and high wear resistance, which can be used in various mechanical sensors and biomedical applications. It is important to understand the theory behind how supercooled liquids act to develop them for future applications. When supercooled liquids are disturbed by an external force, the time it takes for the liquid to return to equilibrium is much longer for normal liquids. We modeled the time it takes to reach equilibrium of these liquids and compared components of the model with experimental data.

** Special presentation by the recipient of the 2021 Janet Liou-Mark Student award*

11:35 a.m. **Exploring the Development of Early Methods in Linear Algebra**

Jake Postiglione, New York City College of Technology, CUNY
Advisor: Ariane Masuda, New York City College of Technology, CUNY

Much like the early stone tools of our ancestors, Mathematics has a deep-rooted relationship with the development of the modern world and civilizations' past. This research examines some of the earliest mathematical tools used by ancient civilizations to solve problems with direct analogs to modern day Linear Algebra. These tools predate much of the mathematical devices and arithmetic systems we are used to in favor of more intuitive numerical relationships and physical computational devices. One of the tools we analyze is detailed in a collection of mathematical problems known as "The Nine Chapters of Mathematical Art" by Liu Hui in 263 A.D. where an early method predating both matrix notation and Gaussian elimination was used to analyze what we know as a linear system. Using a counting board, different colored rods were used to represent the positive and negative coefficients of the system. An elimination method was then used to put the counting board into a state most closely related to the upper triangular form of a matrix. A method equivalent to back substation was then used to calculate the values or weights of each variable. This is but one of the many early examples of how ancient civilizations found solutions to complex mathematical problems using the tools and knowledge available to them at the time. We hope to build upon the early intuition used to solve these problems and bridge the gap between ancient and modern mathematical ideas. We also aim to frame the evolution of these tools in a way to help describe the many numerical nuances often obscured by modern mathematical methods.

11:50 a.m. **Engaging Students and Informal Assessment in Participatory Virtual Environments**

Silvana Quiroz, Violanda Lubani, Jess Topal
Advisor: Nadia Kennedy, New York City College of Technology, CUNY

Schools have faced considerable academic challenges since the recent transition to remote teaching during the COVID-19 pandemic, most particularly in engaging students and in providing adequate feedback and support to students. This presentation focuses on utilizing three virtual platforms: Jamboard, Peardeck, and Desmos, to meet these challenges in online math classes.

12:05 p.m. **Learning Mathematics in College during a Pandemic: STEM Students' Perspectives**

Angela Sadlis, Grace Edwards, Vincent Pecora, Molloy College
Advisor: Deborah Upton

The Covid-19 pandemic has affected the education system drastically, as many college students had to transition from in-person to online classes. After researching its effects, we realized that there was hardly any research done to highlight the effects from a student's perspective. We have created a survey directed to undergraduate STEM majors and minors who have been enrolled in a virtual or hybrid math course due to the pandemic. Our goal for this research project is to gain a better understanding of what students think about virtual learning compared to in-person learning, and how it has affected their learning of mathematics. From these results, we hope to gain insight of students' thoughts and find a better understanding of how students learn virtually versus in-person.

12:20 p.m. **A Textual Analysis on Implicit Racial Biases in State Supreme Court Cases**

Francesca Amato, Adelphi University
Advisor: Carl Giuffre, Adelphi University

Text mining is a tool used by many disciples to extract meaningful information from documents. The Cook Partisan Voting Index (PVI) is a non-partisan measure of how strongly each state leans towards a political party as compared to the nation. In this study, we perform a text analysis on state Supreme Court cases from 2000 to 2020. The Cook PVI is used to select the top five Democratic states and the top five Republican states for analysis with the purpose of exploring social justice issues that may be present. Statistical models are then used to analyze these results and test their significance. We make important observations on these data and state meaningful conclusions based on these observations. The goal of this research is to determine if bias is present in our court system, and if so, if there is a difference between Democratic leaning states and Republican leaning states. This type of study would be beneficial for the public and can help our court system with their decision-making process.

CONTRIBUTED POSTER SESSION

12:40 PM – 1:25 PM

MISCELLANEOUS RESEARCH

Supervisor: Johanna Franklin

Edge detection and convolutional neural networks

Xiaona Zhou, New York City College of Technology, CUNY
Advisor: Boyan Kostadinov, New York City College of Technology, CUNY

We studied how edge detection could be done with convolutional operation. We rewrote the algorithm from scratch in R and compared edge images resulting from different filters, such as Sobel filter and Scharr filter. For a better edge detection outcome, we studied the five steps procedure in Canny Edge Detection in detail and rewrote the code from scratch in R again. We also learned about convolutional neural networks and implemented some of its applications, such as car detection and face recognition.

Prime Counting and the Riemann Zeta Function

Caroline Johnson, Davis Senior High School, Paul Johnson, Biostat Software Development

Four SAS programs explore prime counting, approximations to the Riemann zeta function using primes, and solving the non-trivial zeros of the Riemann zeta function with respect to the Riemann hypothesis. It is interesting to examine patterns for large and extremely large prime numbers. The SAS procedure IML is used to find the first million prime numbers. We examine the approximation of the Riemann zeta function using primes. The Riemann hypothesis is a conjecture that all non-trivial zeros of the zeta function have real part one-half. If the hypothesis is correct all of the non-trivial zeros lie on the critical line ½ + ti. The first few nontrivial zeros occur at Re(½) and Imaginary coefficients t = 14.134725, 21.022040, 25.010858, 30.424876, 32.935062 and 37.586178. We provide a program that uses a search grid to find the imaginary coefficients as we zoom into the non-trivial zeros of the Riemann's zeta function. We examine and comment on Lehmer's phenomenon when some of the solutions for the imaginary coefficients lie extremely close together (e.g., 7005.063 and 7005.101). We examine differences between these 'close together' points and the next-to solutions on the search grid.

Dos Burning

Andrew Velasquezber, Samantha Vicari, Eleni Zamagias, Daniel Delasherasgarcia, Chante Parker, Christopher Benson & Michael Gabriel
Adelphi University
Advisor: Joshua Hiller, Adelphi University

Graph burning was recently introduced as a way to model the spread of information across a complex network. In this work, we explore an alternative to this problem which aims to model the spread of competing ideas across a network via a combinatorial two player game which we call "Dos Burning." Our research looks at winning strategies for different graph configurations. We make use of classical proof techniques, such as mathematical induction, and also computer programing to arrive at our conclusions.

Utilizing a Mathematical Modelling and 3D Printing Activity to Explore and Impact Prospective Teachers Mathematical Competence in the English National Curriculum

Matthew Meangru, University of East Anglia

This study observes preservice teachers enrolled in a Post Graduate Certificate in Education (PGCE) programme in the United Kingdom utilizing a mathematical modelling and 3D printing activity to explore their mathematical affect and competence in key stages 1 and 2 of the English National Curriculum. Research shows that preservice teachers often lack the basic mathematical foundation to teach primary school mathematics to their future students. Some preservice teachers approach mathematics with trepidation and they portray a lack of confidence towards teaching it. In the field of mathematics education, this skeptical perspective toward mathematics is termed "negative mathematical affect." In this poster presentation, I present a mathematical modelling and 3D printing activity that could aid preservice

teachers' mathematical competence and confidence in teaching at the primary school level, thus encouraging a more positive mathematical affect. The mathematical modelling and 3D printer activity in which preservice teachers will participate includes three primary components: (1) an activity that develops their basic understanding of 2-D and 3-D shapes, (2) use of a 3D modelling software called Tinkercad, and (3) the production of shapes, made through Tinkercad, into tangible forms using a 3D printer. The goal of this activity is to reinforce preservice teachers' understanding of the mathematical content in key stages 1 and 2 of the English National Curriculum and build up their confidence to teach at the primary school level.

Maximum Distance Codes over $\mathbb{Z}_4$

Najalia Singh, Valley Stream Central High School
Advisor: Ariane Masuda, New York City College of Technology, CUNY

The parameters of Error-Correcting Codes are important in the transmission of messages through noisy channels. A code with a large minimum distance increases its reliability as more errors can be detected and corrected. Over past decades researchers have given special attention to codes over rings of order 4. An open problem is to find and classify maximum codes over these rings with respect to certain distances. I will present the computational explorations that I did in this direction, using the Lee and Euclidean distances in $\mathbb{Z}_4$.

Practical Mathematics with Theoretical Music

Cadee Lee, Bergen County Academies and Juilliard Pre-College
Advisor: JungHang Lee, Hostos Community College, CUNY

Despite the common misconception that music and mathematics are on opposite sides of the spectrum, many aspects of music can be interpreted, proved, and explained using mathematics. This research focuses on a mathematical analysis of first species counterpoint, a form of music in which a single melody is written over a cantus firmus, or baseline. Counterpoint is one topic in music theory that still causes debate amongst musicians over which techniques "sound better." To resolve this issue, a mathematical approach will be used to examine arguments that music theorists in the past have made about these controversial rules. The rules of counterpoint will be rewritten using mathematical theorems and axioms. Linear and nonlinear multivariable functions, in which variables represent distances between tones, will be used to explain the rules. Instead of using one's ears and intuition to decide what "sounds better," this paper will be using mathematical modeling to conclude which rules are valid and which ones are not. This research will help bring light to the tight relationship between music and mathematics. It will demonstrate that mathematics can also be as beautiful as a symphony. As the French music theorist, Jean Philippe Rameau, said, music after all is a mathematical science with a set of principles and axioms from which all elements of music can be deduced.

Analysis of Surface Temperature Trends of Global Lakes Using Satellite Remote Sensing Observations

Olga Privman, Christal Jean-Soverall , Shaylin Venitelli, Oumou Diallo New York City College of Technology, CUNY
Advisors: Reginald Blake, Hamid Norouzi, Abdou Bah, New York City College of Technology, CUNY

Anthropogenic climate change has made a noticeable impact on our worldwide ecosystem, often leading to cascading effects that impact human lives. Although lakes consist of a small percentage of global water bodies, they nevertheless have significant influence on their surrounding environment, impacting the lives around them. Unfortunately, however, several lake surface areas around the globe have been changing with many of them drastically decreasing due to climate variability and local mismanagement at the basin-scale level. Lake Surface Water Temperature (LSWT) is recognized as a critical indicator of climate change in lakes. The changes in water and the surrounding land temperatures may be an indicator of climate variability if there is consistency between changes in both temperatures. This project focuses on the application of remote sensing to investigate the changes in lake surface water temperatures and their relationship with their surrounding land cover type in a bid to identify the main driving factors of these changes. In this study, 507 global major lakes have been investigated. An analysis of temperature variation over these lakes has been conducted using daily observations from the Moderate Resolution Imaging Spectroradiometer (MODIS) from 2002 to 2018 over the lakes and their surrounding land areas. The rates of change of temperature for both the lakes' water surface and their basins as well as the changes in the lakes' surface areas were calculated. The relationship between the rates of LSWT change and other lake characteristics such as lake depth, salinity level, geographical location, and size were also investigated. Moreover, changes in the occurrence in the timing of the annual formation and disappearance of lake ice in the United States were examined. Preliminary results show that many of the lakes' water temperatures are warming faster than their surrounding land temperatures. In addition, approximately 43.15% of the studied lakes are warming, and about 51.00% of them are cooling. Furthermore, 62.53% of the lakes are shrinking while 28.35% of them are growing. Moreover, as latitude increases, the difference between the water temperature and the air temperature increases and vice versa. This study, therefore, provides insights about LSWT variability on a global scale.

Downscaling Methodology for Satellite Land Surface Temperatures over Urban Environments

Naved Khan, Ruben Vecino, New York City College of Technology
Advisors: Reginald Blake, Hamid Norouzi, Abdou Bah, New York City College of Technology, CUNY

A linear regression method was developed and tested to derive high spatial and high temporal resolution Land Surface Temperature (LST) products using a combination of Landsat 8 Thermal Infrared Sensor and the Geostationary Operational Environmental Satellite-R Series (GOES-R). Landsat 8 provides high spatial resolution (30 m) estimates of surface temperature every 16 days, and GOES-R, which has lower spatial resolution (2 km), evaluates the surface temperature at a much higher temporal resolution (5 minutes). There is a systematic bias between Landsat 8 and GOES-R in temperature measurements even at the same time and spatial scales due to sensor configurations, footprint size, radiometric and spectral differences and retrieval algorithm. The linear regression model used to downscale GOES-R to Landsat 8 spatial resolution every 5 minutes accounted for the systematic differences between the two satellites by removing the average of Landsat 8 temperature from the GOES-R LST observations. Additionally, the temporal differences between the land cover types at finer resolution were also accounted for. The disaggregated results were comparable to the observed Landsat 8 LST for the same measurement time. The downscaled estimates showed reasonable agreement (0.63 K error and RMSE of 1.61K) when they were validated against independent Landsat 8 images. Preliminary results also revealed that the proposed model can reasonably estimate LST in urban regions. High resolution LST for cities may improve prediction of heat indices and the effects of urban heat islands. Improving indices and understanding heat islands are crucial for sustainable and resilient urban environments.

Green Hybrid Renewable Energy Systems

Sherene Moore, Jude Vallon, Myatkwar Thar, New York City College of Technology, CUNY
Advisor: Masato Nakamura, New York City College of Technology, CUNY

Green hybrid renewable energy systems that create a smart electrical grid and sustainable power, are necessary in New York City, to facilitate its carbon footprint reduction initiative by 2050. A design deficit of conventional wind turbines is that continuous vibrations impact soil-structure stability; thus, resulting in pressure uplift of the foundation. A modified compact design of vertically aligned turbine blades, along with reinforced cone-shape concrete foundation, can decrease the resonance of soil-structure interaction. Energy efficient hybrid solar wind systems, like the NLIL smart vertical axis solar panel wind turbine, creates an efficient solution for a metropolis where space is an issue. These machines are small and lightweight enough to be placed on high-rise rooftops, sidewalks, and highways; while using wind, solar, and passing automobiles to create electricity. The presence of these turbines would also mean more available electrically powered charging stations for electric motor vehicles; which emit zero carbon, are eco friendly, low maintenance, cheaper than fuel, and able to travel from 100-200 miles fully charged. These turbines would significantly assist in resolving the sustainable issues for NYC, as they measure temperature, the CO2 footprint using built-in sensors and IOT platform; while charging batteries of electric cars and metrobuses.

Streamflow Prediction using Deep Learning in Lower Cosumnes Watershed, California

Arezoo Bybordi, The City College of New York, CUNY
Ana Abreu, Bronx Community College, CUNY
Advisor: Ronak Etemadpour, The City College of New York, CUNY

Streamflow is the flow of water in streams, rivers and other channels. Changes in streamflow can influence the amount of water available for crops, the generation of electricity, fishery, many plants and animals. The goal of this project is to predict daily streamflow values of locations in one of the locations in the Lower Cosumnes watershed which is in California and in the west of the US using a deep learning model and compare its performance to a baseline model and specially for peak detection uses. Daily streamflow data from years 1980 to 2019 is derived from the US Geological Survey, and daily precipitation measurements have been derived from the University of Idaho's Climatology Lab for the same duration. The measurements include the data for six locations inside the Lower Cosumnes watershed. Having many dry locations in the West of the US which interferes with the performance of the usual models, and the use of deep learning methods for a location in the West of the US are our challenges. An important measurement that affects the streamflow is precipitation and therefore we have decided to take it into consideration. In order to get a sense of the dryness in six locations (Dry C A Union City 11180500, Arroyo Valle BL Land CYN NR Livermore 11176400, Arroyo Valle NR Livermore 11176500, Alameda C Flood Channel A Union City 11180700, and Castro Valley C A Hayward 11181008) inside the Lower Cosumnes watershed, we have visualized the streamflow in different months. We have suggested which months are to be considered as dry months. We have limited the analysis to a specific watershed (Lower Cosumnes watershed) since the locations inside a watershed have similar climatic patterns. We have used bar charts and heatmaps for this analysis. For the prediction, we have predicted streamflow using windows of 7, 10, 14 and 30 days of streamflow and precipitation data. The main method used was a deep learning model including a LSTM layer. Then, using Support Vector Regression as a machine learning model, we built a baseline model for windows of 7, 10, 14 and 30 days of streamflow data. Different window inputs have been chosen to make comparisons of results and determine the best window length. Currently, we are also investigating the effect

of different preprocessing methods such as the usual normalization and z-score normalization for all the methods used for anomaly detection purposes. A model with the capability to detect streamflow anomalies can be utilized for flood management purposes.

How is clothing affecting the environment?

Nicole Torres, Noor Najam, Maria Deleon, New York City College of Technology, CUNY
Advisor: Valerie Were, New York City College of Technology, CUNY

Have you ever noticed that some plastics that end up in the environment do not biodegrade? Instead, they are fragmented into smaller pieces. Microplastics are plastics that are less than 5mm in length. Microfibers are the most abundant type of microplastics (Xu, et al., 2018). They are the teeny-tiny particles of synthetic and non-synthetic material that come off of our clothing during the wash cycle (Hirsh, S., 2019). Both synthetic and non-synthetic microfibers have a negative effect on our environment due to their insolubility in water (Sewport, 2019). For example, fish eat microfibers without knowing because the fibers are so small. When they eat them, the fish have less space in their stomachs for their actual food that they really need. The synthetic microfibers come from clothes that are made with polyester, acrylic, and nylon (Sahven.V, et al. 2019). It is harder for synthetic materials to break down in the environment because they are made from chemicals. Given that synthetic fibers are less prone to breakdown, they cause more unfavorable effects, for example, they absorb a wide variety of pollutants (Sewport, 2019). This research focused on comparing clothing among stores in New York City to determine which store's clothing will contribute the most microfibers to the environment. The results can be used to inform the stores about their potential environmental impact so they can consider alternative materials.

Investigating Water Usage Patterns tied to California State Water Project

Xiaoqing Wu, The City College of New York, CUNY
Advisor: Indrani Pal, The City College of New York, CUNY

California is the largest agricultural producer and one of the populous states in the United State. As the population and agriculture grows, water consumption patterns become crucial to keep track of. California State Water Project (SWP) is the largest water storage and distribution system in the United State, and it is managed by the California Department of Water Resources (DWR). It is two-third the length of California, and it consists of 27 public water agencies from Northern, Central, and Southern California. It serves millions of gallons of waters to California residents and farmland irrigation. In this research project, we explore the water usage across California of who receives water from SWP. The purpose of this research is to study possible changes in water consumption patterns in different districts, water users, and water rights holders who obtain water supply from SWP. Additionally, we want to investigate if there are any impacts of water rights law on the water usage patterns. The results can help water managers to make a better decision in the future of water supply distributions.

Connecting Communities and Research: The Urban Heat Island Effect in Bedford-Stuyvesant, Brooklyn, New York

Lucy Piacentini, New York City College of Technology, CUNY
Advisors: Reginald Blake, Hamid Norouzi, New York City College of Technology, CUNY

In partnership with the Magnolia Initiative community advocacy group in Bedford-Stuyvesant, Brooklyn, New York, various facets to increase community engagement in STEM (Science, Technology, Engineering and Math) in general, and in the geosciences in particular, were explored. The geoscience partnership focused on the Urban Heat Island Effect (UHIE) which occurs when higher temperatures are experienced in urban areas as compared to their surroundings. This urban/geophysical phenomenon can cause various heat-related illnesses and affect the overall health of urban communities. Using Landsat 8 and Moderate Resolution Imaging Spectroradiometer (MODIS) Aqua satellite data, comparisons were made between the land surface temperatures of Bedford-Stuyvesant and other neighborhoods within New York City. Micro-level survey data was also collected from Bedford-Stuyvesant residents to assess factors that contribute to heat wave exposure and heat-related health risks. The COVID-19 pandemic has created an importance in connecting with the community in a socially distant setting. Interactive maps and a website were developed on an online platform for the community to emphasize how socio-economic and geophysical factors compound to exacerbate the UHIE in the community. Preliminary results show that Bedford-Stuyvesant is one of the most heat vulnerable communities in New York City and highlight the importance of sharing mitigation and adaptation strategies with community-folk in a manner that they can comprehend and easily implement in a neighborhood bid for sustainability and the amelioration of heat-health risks. The survey and the interactive map have been implemented and have proven to be a positive community engagement tool!

Forecast Error Signature Detection

Stance Mason, Bronx Community College, CUNY
Hannah Aizenman, The Graduate Center, CUNY
Advisor: Michael Grossberg, The City College of New York, CUNY

Incorrect weather forecasts can be deadly and very costly; therefore, it is important to explore where and why weather forecasting makes errors. In this work, we analyze the distribution of errors when making predictions further in advance. Our weather forecasts come from the Global Forecasting System (GFS) Model Output Statistics (MOS). MOS is a statistical process that is based on a linear regression of a numerical model forecast tuned against observational data. The Global Historical Climatology Network (GHCN) is another database of ground-observations from weather stations around the world. For our research, we concentrated on stations in the United States. As a case study, we computed the differences between the MOS forecasts and GHCN observations for 2019. By looking at this data in a time series, we understood where there were recurring errors. With this data, we can calibrate the model to make better predictions.

Estimating hourly brightness temperature data using SSMIS and GMI sensors

Zahra Sharif, Mamadou Balde, New York City College of Technology, CUNY
Advisor: Reginald Blake, Hamid Norouzi, New York City College of Technology, CUNY

Passive microwave radiometers provide brightness temperature (Tb) measurements in large spectral frequencies. These Tb data connect many land and atmospheric parameters that provide useful information about surface energy, hydrological cycle activity, soil moisture, land surface emissivity, freeze and thaw state, water vapor and land vegetation dynamics. Tb is measured at different spatial resolutions and frequencies by a variety of sensors onboard different satellites. Therefore, the data, although aimed at the same phenomenon, are somewhat distinct and consequently need to be harmonized and merged in order to build a congruous and complete diurnal cycle of Tb out of the sensors. This study utilizes Tb measurements from two sets of sensors: The Global Precipitation Measurement (GPM) Microwave Imager (GMI) and Special Sensor Microwave Imager Sounder (SSMIS) series on board the Defense Meteorological Satellite Program (DMSP) F16, F17 and F18. It primarily aims at integrating the available daily data to estimate an hourly Tb diurnal cycle for common channels. In the next step, it focuses on identifying the daily variations of Tb and its worldwide pattern for the duration of a whole year. At last, the identified patterns are juxtaposed to be corroborated and the prospect of attaining optimum values are probed.

The Effects of Late Spring Frost on Forest and Landscape Health of the Black Rock Forest, New York

Caroline Eco, Oliver Imhans, New York City College of Technology, CUNY
Advisor: Aaron Davitt, The City College of New York, CUNY

Projected changes in climate are expected to increase the frequency of late spring frost events in the Northeast US. Such events can be harmful to trees because freezing temperatures that occur after leaf-out can damage or kill young leaves. The resultant defoliation typically forces a second flush of leaves, but delays canopy development, which in turn delays the onset of canopy carbon uptake and alters canopy thermal properties. While forest response to defoliation events has been studied, much of this work has focused on insect-driven events (e.g., gypsy moth), which often occur later in the season and likely have different ecological implications than spring frost-induced defoliation events. Here, we use satellite-based remote sensing analyses to study the impacts of spring frost-induced defoliation on canopy green-up dynamics in a temperate deciduous forest. In this study, we analyzed a recent freeze event that occurred on May 8-9, 2020 (DOY 129- 130) at Black Rock Forest (BRF), which is located in the Hudson Highlands of southeastern New York State. We compared satellite images collected during the 2019 (no frost) and 2020 growing season. The purview of this analysis includes: 1. A comparison of the current year to the previous year to determine the productivity of forest ecosystems and their ability to bounce back after the frost. 2. The impact of the frost event on landscape thermal properties by comparing growing season land surface temperature between the year with the frost event (i.e. 2020) to previous year (i.e. 2019). We use the Landsat-8 Normalized Difference Vegetation Index (NDVI) to assess spatial and temporal patterns in canopy development. The land surface temperature (LST) is used to measure the temperature of the forest before and after the frost. The mean results of the NDVI value from Landsat-8 data highlights the differences in the timing of greenness between the two years. After DOY 129-2019 and DOY 130-2020, there is a decrease in NDVI for 2020 which suggests a delay in the canopy development. Analysis of ECO system Spaceborne Thermal Radiometer Experiment (ECOSTRESS) imagery indicates a rise in LST after 9 May 2020. LST patterns after 9 May 2019 are higher than that of 2020 from mid-May to early June. The mean LST of low elevation forests which did not defoliate shows that higher elevation is hotter than other locations.

Ozone (O3) and Particulate Matter (PM2.5): a spatial and temporal variability of pollutants concentration in the New York City (NYC) urban sites and coastal areas resulting from the 2020 summer heat-wave.

Ding Dong Li, Babacar Dieng, The City College of New York, CUNY
Advisors: Fred Moshary, Yonghua Wu, The City College of New York, CUNY

In this study, we aimed to analyze high Ozone (O3) episodes during the heat-wave period during the summer of 2020 in the New York City (NYC) region. We investigated the spatial and temporal variability of O3 and PM2.5 associated with different air transport patterns or meteorological conditions in NYC urban and coastal sites. We will show the observed O3 exceedance of the National Ambient Air Quality Standard (NAAQS) during the heatwave period in July 2020. The hourly O3 attains 100 ppb and indicates dramatic spatial/temporal variation in the Long Island coastal area. We will further analyze the NOx and meteorological parameters (temperature and wind) that potentially affect the O3 and PM2.5 variability using the integrated measurement at the air quality (AQ) and weather stations. The dataset includes the two majors pollutants: O3 from eight (8) ozone monitoring sites, PM 2.5 from ten (10) PM2.5 monitoring stations, as well as the meteorological data (Temperature, Wind speed, Wind direction, Cloud Cover, Precipitation) near those AQ sites.

Real-time control system architecture for an automated mechanism

Ana Zikovska, St. Joseph's College
Advisor: David Seppala-Holtzman, St. Joseph's College

Real-time Control System Architecture is essential to the regulation of electronic actuators, especially, when gentleness of operation is highly prioritized. The sensor analysis to the desired pressure at touch when handling an egg for example helps to establish a natural limit to the action. The machine in our case learns through a trial-and-error approach to break the execution of the grip and to afterwards proceed with movement. Further research suggests that use of visual sensors may aid a superiorly accurate grip based on object surface analysis.

Linear Algebra for Computer Graphics

William Pollicino, New York City College of Technology, CUNY
Advisor: Ariane Masuda, New York City College of Technology, CUNY

The objective of this project is to explore the critical elements of Linear Algebra that are used in Computer Graphics. Through the manipulation of algebraic matrices, three-dimensional images undergo the transformations of rotation, translation, and scaling to obtain new views of said image. An image or object is represented by an xyz-coordinate system, which is split into n numbers of straight-line segments with respective endpoints. When scaling an object along the x, y, and z directions, the coordinate system matrix of the image is multiplied by a diagonal matrix which includes the factors of scaling required. When translating an image, the matrix of the original position is added by the translation vector, which specifies the new coordinates of the image. Rotating an image requires the use of the trigonometric functions sine and cosine, in which a rotation matrix including the functions along with angles of rotation is multiplied by the original coordinate matrix. In the project, these transformations are implemented using the GeoGebra software, which will provide a visual depiction of how these transformations are used to affect an image.

Problem Solving with Harmonic Geometry

John Gupta-She, Stuyvesant High School
Advisor: Joseph Stern, Stuyvesant High School

Harmonic Geometry is a powerful tool for solving difficult problems. It is a special way of looking at ratios in a geometric figure. Most problems can be solved with only the two most important constructions: the harmonic bundle on a line and the harmonic quadrilateral on a circle. In this article, we explore its practical uses in problem solving and competition math.

An Internet Search Engine

Allan Emmanuel, New York City College of Technology, CUNY
Advisor: Ariane Masuda, New York City College of Technology, CUNY

Search engines are designed to carry out web searches from the world wide web. The first internet search engine software was created in 1990. Today, some of the most popular ones are Google search, Yahoo! Search, and Bing. They are some of the most visited websites on the internet and are useful at recommending links based on some of the keywords that a user types. This project will focus on using linear algebra to rank websites from the most visited to the least visited.

Exploring the Development of Early Methods in Linear Algebra

Jake Postiglione, New York City College of Technology, CUNY
Advisor: Ariane Masuda, New York City College of Technology, CUNY

Much like the early stone tools of our ancestors, Mathematics has a deep-rooted relationship with the development of the modern world and civilizations' past. This research examines some of the earliest mathematical tools used by ancient civilizations to solve problems with direct analogs to modern day Linear Algebra. These tools predate much of the mathematical devices and arithmetic systems we are used to in favor of more intuitive numerical relationships and physical computational devices. One of the tools we analyze is detailed in a collection of mathematical problems known as "The Nine Chapters of Mathematical Art" by Liu Hui in 263 A.D. where an early method predating both matrix notation and Gaussian elimination was used to analyze what we know as a linear system. Using a counting board, different colored rods were used to represent the positive and negative coefficients of the system. An elimination method was then used to put the counting board into a state most closely related to the upper triangular form of a matrix. A method equivalent to back substation was then used to calculate the values or weights of each variable. This is but one of the many early examples of how ancient civilizations found solutions to complex mathematical problems using the tools and knowledge available to them at the time. We hope to build upon the early intuition used to solve these problems and bridge the gap between ancient and modern mathematical ideas. We also aim to frame the evolution of these tools in a way to help describe the many numerical nuances often obscured by modern mathematical methods.

Moore Graphs and the Degree-Diameter Problem

Luc Telemaque, New York City College of Technology, CUNY
Advisor: Nadia Benakli, New York City College of Technology, CUNY

The Degree/Diameter problem is a famous problem in combinatorics. Given two positive integers k and D, the problem consists of finding a graph with the largest possible number of vertices, $n(k,D)$, that has maximum degree k, and diameter D. An upper bound for $n(k,D)$ is called the Moore bound. Graphs for which $n(k,D)$ is equal to the Moore bound are called Moore graphs. The Degree/Diameter problem has several applications such as the construction of large interconnection or microprocessor networks. In this project, we explore the existence problem and construction of the Diameter 2 Moore graphs.

Spanning Tree Congestion, Stretch, and other parameters of the graph

Isaac Moorman, Rainah Khan, St. John's University
Advisor: Florin Catrina, St. John's University

In this presentation we introduce a new characteristic of connected simple finite graphs which we term support number. We present relations with the previously defined notions of congestion and stretch. We also give an approximation algorithm for support number, and thus a polynomially computable lower bound for stretch.

Investigating the Activity of Coupled Neurons

Maxwell Bohling, Parul Rai, Manhattan College
Advisor: Lawrence C. Udeigwe

In the present project, we explore synchronous and asynchronous spiking patterns of coupled integrate-and-fire neurons with synaptic conductance. We investigate the interaction between two coupled neurons with chemically exciting or inhibiting synapses. Our results suggest excitatory coupled neurons produce asynchronous spiking patterns, inhibitory coupled neurons produce synchronous spiking patterns, and mixed synapse types exhibit characteristics of both spiking patterns.

A Numerical Investigation of the Wilson-Cowan Model

Maxwell Bohling, Andrew Cirincione, Manhattan College
Advisor: Lawrence C. Udeigwe

In the present project, we investigate various numerical properties of the Wilson-Cowan model. This model describes the dynamics between excitatory and inhibitory subpopulations of neurons from a macroscopic perspective. We investigate the stability of this model under the ReLU and shifted logistic sigmoid activation functions, obtain parametric regimes that guarantee certain stability behaviors (including stable and oscillatory steady states), and explore possible biological implications of our results. Lastly, we use the BCM rule to vary the synaptic weights (with time) between the subpopulations in the Wilson-Cowan model. Our preliminary results suggest that introducing the BCM rule does not change the types of steady states we observe in the absence of the BCM rule, however, the previously established parametric regimes may no longer hold.

Parametric Art

Daanial Ahmad, Shaun Pollard, New York City College of Technology, CUNY
Advisor: Satyanand Singh, New York City College of Technology, CUNY

Lissajous curves which are named after the Mathematician Jules Antoine Lissajous (1822-1880) are generated from the parametric equations in its simplest form that is $x=Acos(at)$ and $y=Bsin(bt)$. Prior to Lissajous, Mathematician Nathaniel Bowditch had also studied these curves in 1815 that's why they are also called Bowditch curves. These curves can be found in engineering, mathematics, graphic design, physics and in many other disciplines.

Stochastic Processes: Random Walk, Brownian Motion and Stock Prices

Daanial Ahmad, Jose Sanchez, New York City College of Technology, CUNY
Advisor: Satyanand Singh, New York City College of Technology, CUNY

We will begin by presenting Brownian Motion as a Wiener process as well as a random walk. We will then introduce fluctuations of financial indices and relate them to Brownian motion and the modeling of stock prices.

Cluster Analysis of Students' Abilities to Gauge Their Own Mathematical Abilities Based on In-Class, Low-Stakes Assessments

Caleb Sheffield, United States Military Academy

While teaching in the Advanced Mathematics Program (AMP) at the United States Military Academy (USMA) at West Point, a colleague and I chose to implement weekly quizzes with questions similar to some which would be seen on mid-term exams. One set of students was given the opportunity to report their quiz performance without risk to their grades, and later to express their confidence with the material prior to the exams. The other set of students reported their score to the teacher in class immediately following the quiz. The latter set is used as a control because they do not provide a measure of confidence with the quizzed/tested material. This research explores how well students assess their own abilities, whether there are groups of student types or behaviors, and whether a student's confidence is correlated to their mid-term exam scores or overall class grade.

CONTRIBUTED PAPER SESSIONS II

1:30 PM – 3:00 PM

RESEARCH SESSION: APPLIED MATHEMATICS II

Presider: Boyan Kostadinov

1:30 p.m. **Nonlocal Theory of Heat Conduction**
Yozo Mikata, Fluor, Schenectady, NY

In this paper, we study a nonlocal theory called peridynamics. Peridynamics has been studied since the pioneering work by Silling (2000), and it has been applied to many different engineering problems including heat conduction. Here, peridynamics for transient heat conduction problems in general anisotropic materials is developed. In order to develop a new peridynamic governing equation for heat conduction problems, the microconductivity (or microdiffusivity), which contains equivalent information as the constitutive equation for classical heat conduction, is determined by directly requiring the resulting peridynamic equation to converge to a classical heat conduction equation for anisotropic materials as the generalized material horizon approaches 0 in the classical local limit. Unlike several existing studies on peridynamic heat conduction, where the development of the theory relies on heuristics to some degree, the development of the theory in this paper is completely analytical. Example problems for the 3D peridynamic heat equation developed in this paper are also analytically solved. These are believed to be the first exact analytical solutions for peridynamic heat conduction.

1:45 p.m. **Applying the FFT in Quantitative Finance**
Sebastian Toro, Farmingdale State College, SUNY

The Fourier transform and its fast implementation, the fast Fourier transform (FFT), is a workhorse in both pure and applied mathematics. One area where the FFT has found surprising application is in the field of quantitative finance and option pricing. An option is a derivative security which gives the owner the right to purchase or sell an underlying asset at a particular price (i.e., strike) . In our research, we show how an option's price can be viewed as the inner product of the option's payoff function and the underlying risk-neutral probability distribution. Traditionally, options are priced using the well-known Black-Scholes formula or, if required, a binomial tree approximation to the underlying stochastic process. We show that the calculation speed of binomial tree option prices can be significantly improved using the FFT without loss of accuracy. In addition, taking advantage of the convolution theorem, we derived a technique to use the FFT to simultaneously price a set of options, over a range of strikes, without the need of a computationally expensive for-loop. This is particularly important when the log-normal distribution, which underlies the Black-Scholes formula, cannot be assumed. Thus, we have studied how the Fourier transform relates to probability distributions and their characteristic functions. Through the FFT, we generate probability distributions from a parameterized family of characteristic functions which grants us the flexibility to adjust the underlying probability of a given option payoff to fit actual market data without sacrificing computational speed

2:00 p.m. **Investigating the Activity of Coupled Neurons**
Maxwell Bohling, Parul Rai, Manhattan College
Advisor: Lawrence C. Udeigwe

In the present project, we explore synchronous and asynchronous spiking patterns of coupled integrate-and-fire neurons with synaptic conductance. We investigate the interaction between two coupled neurons with chemically exciting or inhibiting synapses. Our results suggest excitatory coupled neurons produce asynchronous spiking patterns, inhibitory coupled neurons produce synchronous spiking patterns, and mixed synapse types exhibit characteristics of both spiking patterns.

2:15 p.m. **Parametric Art**

Daanial Ahmad, Shaun Pollard, New York City College of Technology, CUNY
Advisor: Satyanand Singh, New York City College of Technology, CUNY

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2:30 p.m. **Stochastic Processes: Random Walk, Brownian Motion and Stock Prices**

Daanial Ahmad, Jose Sanchez, New York City College of Technology, CUNY
Advisor: Satyanand Singh, New York City College of Technology, CUNY

We will begin by presenting Brownian Motion as a Wiener process as well as a random walk. We will then introduce fluctuations of financial indices and relate them to Brownian motion and the modeling of stock prices.

2:45 p.m. **Intersecting Lines in the 4-dimensional space over $\mathbb{Z}_3$**

Shagun Bothra, Fairfield Ludlow High School
Advisor: Janet Striuli, Fairfield University

We answer a question from the game SET by counting non-intersecting lines in the four-dimensional space over $\mathbb{Z}_3$.

RESEARCH SESSION: PURE MATHEMATICS II

Presider: Johann Thiel

1:30 p.m. **Generalization Theory of Linear Algebra III**
Christina Pospisil

The talk continues the presentations Generalization Theory of Linear Algebra I+II from JMM 2019 and JMM 2020. In the first part an algorithm for multiplying matrices regardless of dimensions via an embedding and inverses for non-injective mappings in one dimension were presented (first part was presented at JMM 2019). The second part presented inverses for non-injective mappings in one and multiple dimensions and introduced a general determinant theory (second part was presented at JMM 2020). The third part is dedicated to a further generalization regarding tensors with first applications in physics. In future work there will be further operations and applications to physics and other natural sciences be explored. (JMM = Joint Mathematics Meeting)

1:45 p.m. **Some Interesting Patterns Embedded In Pascal's Triangle**
Jay Schiffman, Rowan University

One of the most appealing configurations in mathematics is embodied in Pascal's Triangle. This paper focuses on locating neat entries in the configuration where the triangle is written in a rectangular array. Terms of integer sequences that represent the number of squares and the number of rectangles in a square grid are located in an L-shaped (hockey stick) form. We also locate the Fibonacci, square, triangular and tetrahedral numbers to name a few intriguing integer sequences. There is always something new to discover with this configuration. Enjoy and partake of some engaging mathematics.

2:00 p.m. **Average size of randomly-generated dominating sets - an experimental approach**
Max Sehaumpai, City College of New York, CUNY
Advisor: Michael Wijaya, Bard High School Early College Queens

Let G be a graph and V(G) be its set of vertices. A subset S of V(G) is a dominating set if every vertex in V(G) is either in S or adjacent to a vertex in S. We are interested in the average number of vertices in a randomly-generated dominating set of G, which we denote by gamma_avg(G). To generate data, we applied a variety of methods which include explicit enumeration, simulations to estimate probabilities, and reformulating the random generation of dominating sets as a Markov process. We then used the Online Encyclopedia of Integer Sequences (OEIS) to help us recognize patterns in our experimental data. For example, our discovery of a recurrence relation satisfied by gamma_avg(G), where G is a linear graph, was motivated by an article on a related problem referenced on the OEIS. In this preliminary report, we will explain the experimental methods we used to arrive at our conjectures about gamma_avg(G) for linear and cyclic graphs as well as the proofs of some of these conjectures.

2:15 p.m. **Using GeoGebra as a Tool for Geometric Problems I**
José Contreras, Ball State University

In this presentation I will illustrate how learners can use GeoGebra as a tool to facilitate modeling geometric problems. In particular, I will explore the picnic problem (a version of Viviani's problem): Three towns are the vertices of an equilateral triangle. The sides of the triangle are the roads that connect the towns. A picnic area will be constructed such that the sum of its distances to the roads is as small as possible. a) What are all the possible locations for the picnic area? b) For practical reasons, what is the best location for the picnic area? Justify your response.

2:30 p.m. Using GeoGebra as a Tool for Geometric Problems II

José Contreras, Ball State University

In this presentation, I illustrate how I guide my students to discover that the area of the medial quadrilateral EFGH of a quadrilateral ABCD is half the area of the quadrilateral ABCD. We normally start our exploration with the following special version of the problem: Let E, F, G, and H be the midpoints of the consecutive sides of a square ABCD. Is there a relationship between the area of quadrilateral EFGH and the area of quadrilateral ABCD? After discovering this beautiful result, I guide my students to develop several strategies to prove the result. I will discuss some of these strategies during the presentation.

2:45 p.m. Cross institutional undergraduate math research (for beginners)

Josh Hiller, Adelphi University
Andrew Penland, Western Carolina University

In 2019 two naïve but enthusiastic discrete mathematicians (separated by many states) had an idea: "let's start a band...and by band we mean research group." This began a two-year process jointly mentoring a total of 16 students over multiple projects including game theory, number theory, and applied math. Some things worked well and some did not. In this talk we will share candid experiences and insights from this journey.

PEDAGOGY SESSION: MATHEMATICS EDUCATION II

Presider: Nadia Kennedy

1:30 p.m. **Bending Technology One Math Hub at a Time: Organizing an Online Course Repository**

Marianna Bonanome, Ariane Masuda, Katherine Poirier, Jonas Reitz (Project Director), Satyanand Singh, Lin Zhou, New York City College of Technology, CUNY

In the face of the pandemic, a team of Mathematics faculty at City Tech created a series of Course Hubs to address a glaring need for faculty and students across all schools. The Course Hubs, each boasting a collection of vetted open source materials that address core topics, were created through the OpenLab Model Course Initiative and made publicly available on the OpenLab, City Tech's open digital platform for teaching, learning, and collaboration. In the space of a few weeks, Hubs were created for seven different math courses, including the traditional sequence from Algebra through Calculus and a number of others. In preparation for a fully-online semester and in support of a large and heterogenous department, the team collected student- and faculty-facing resources to support a wide variety of distance-learning activities and approaches, including online lessons, course coordination information, and more. We will outline our design approach.

1:45 p.m. **Bending Technology One Math Hub at a Time: Use of the Hub and its Impacts**

Marianna Bonanome, Ariane Masuda, Katherine Poirier, Jonas Reitz (Project Director), Satyanand Singh, Lin Zhou, New York City College of Technology, CUNY

In this presentation we describe the impact of our course Hubs when they went live, and highlight some of their advantages. Faculty will discuss their use of technology in enhancing the Hubs and give a brief on their course. The talk will culminate with a discussion of the Hub's future impact on instruction from both face-to-face and an online perspective.

2:00 p.m. **Lessons learned from navigating a calculus course through a pandemic**

Shane K. Smith, Lee Evans & Tyson Walsh, United States Military Academy, West Point

This work analyzes publications written on different teaching modalities and how each applies to the on-going COVID-19 pandemic. Discussion focuses on the positives and negatives of teaching and learning in a virtual, classroom, or "hybrid" environment. Although arguments are easily made for each environment, especially given different institutional objectives, this work focuses on why the Department of Mathematical Sciences Multivariable Calculus course leadership preferred teaching classroom setting over alternative options given the unique learning environment at the United States Military Academy. In addition to explaining why course leadership chooses a face-to-face classroom setting, authors offer Measures of Performance to compare how the current COVID-19 semester ranks against previous semesters. Results are compared and analyzed to support two major conclusions drawn from our decision to teach in person under a time constrained environment. Learning modality matters in mathematics and this pandemic will alter student comprehension for semesters to come.

2:15 p.m. **Doing Away With Partial Credit**

Robert R. Craig, United States Military Academy, West Point

Seemingly every math teacher is confronted with students surviving a course on partial credit. It is possible that during an entire semester a student may not get a single problem (from alpha to omega) completely correct. In this case, the student may leave the course with only partial comprehension and understanding yet the passing grade communicates sufficient knowledge to move on. This presentation shares our attempt to address this problem in a college-level precalculus course using a Mastery Grading approach. While requiring students to demonstrate mastery on a subset of course objectives we observed at least two benefits, namely 1) a structure where deep understanding can be achieved and 2) diminished likelihood of students merely surviving a course with minimal effort. Our version of mastery grading focuses on the most basic course objectives and requires both a written and in-person demonstration of mastery proficiency. No program, initiative, or idea is implemented without considering the expense of a teacher's most valuable commodity – time. Our Mastery grading program does cost the instructor some time, but we have minimized the cost by incorporating it into already allotted class time and keeping the requirements simple so that the student quickly learns what is required. Whether you teach a course that is designed to produce engineers and scientists, or you are teaching a course where you are contributing to the numeracy of the entire population, we hope our ideas can help in your pursuit.

2:30 p.m. Writing Syllabi that Promote Equity and Embrace Diversity and Inclusion

Lucie Mingla, New York City College of Technology, CUNY

In this presentation I will be discussing some of best practices in writing an inclusive syllabus for a course. Because this document is essential for Faculty and Students, all are invited to ask questions and share ideas at the end. The syllabus is the fundamental document that establishes communication and behavior throughout the course. Not only it sets all the expectations in terms of the course objectives and outcomes, but it must state clearly the methodology, pedagogy, and approaches that we use to achieve the goal. Without an inclusive syllabus, we always will leave some students behind. Using multiple ways of active learning and inclusive resources and strategies, promoting modeling, and respecting the dialogue from different points of view, communicating policies that establish behaviors that are inclusive and consider various perspectives of the audience, are some of the treasures for creating a rich community. Syllabus gives students a first impression about what to expect, and also helps the instructor set the class climate, communicate specific learning expectations, and discuss various options and needs for all students .Ensuring multiple means of engagement, action and expressions, and representations that are clearly communicated in the syllabus leads to a successful course outcomes for all students.

2:45 p.m. War and Peace in Mathematics Education: Teach to Build ICBM or Bridge

JungHang Lee, Hostos Community College, CUNY

This research addresses mathematics education in one of the most closed yet fast-changing countries in the world — North Korea, as an extreme example of political and social influences on mathematics education. It is one of the few countries which developed a nuclear program and tested several intercontinental ballistic missiles (ICBM). How would a county with $1,300 GDP per capita, North Korea, develop these programs which require scientific and mathematical advancements? How do they teach mathematics? There were several attempts to examine North Korean mathematics education based on textbooks and curriculum analysis since it is extremely difficult to freely visit or observe any schools in North Korea. To capture the true perspectives of mathematics education in North Korea, in-depth interviews were conducted with defectors, who are now in South Korea, former mathematics teachers, and students. Workers' Party's influence on mathematics education and the persistent impact of the March of Suffering are examined. Mathematically gifted student's programs are also examined. There are two main focuses. One is to introduce an extreme case study of mathematics education in North Korea influenced by social and political standpoint. Another purpose is to broaden the understanding of mathematics education as not only a self-regulating subject, but also as an interwoven matter shaping and shaped by the vessel and the people in it.

STUDENT/FACULTY SESSION II

Presider: Benjamin Gaines

1:30 p.m. **Variants of mu torere**

Kira Grossman, George W. Hewlett High School
Maciej Obrebski, Brooklyn Technical High School
Advisor: Johanna Franklin, Hofstra University

Mu torere is a 2-player abstract strategy game where players take turns moving one of their stones into an empty space on the game board. We experiment with changing the rules of this game in order to find the least complex and most feasible variant of the original game. In the original game, there are 8 total pieces and 9 spaces. After analyzing mu torere mathematically, we increased the board size and investigated games with 10 total pieces and 11 spaces and 12 total pieces and 13 spaces. We then tested the different ways that the game could be played with these changes and how interesting and complicated they would be. We found that for both boards of increased size, the majority of starting configurations need restrictions in order to prevent an automatic win on the first or second move. All games have the same rules as the original mu torere, but most boards have the restriction that in order to move into the center for the first time, the moved piece needs to be adjacent to an opponent's piece.

1:45 p.m. **Mana-positive Mana Rocks**

Joseph Ronzetti, Hofstra University
Advisor: Johanna Franklin, Hofstra University

This project is a statistical analysis of the trading card game Magic The Gathering. I wanted to analyze the effects that mana-positive mana rocks have on the number of turns it takes for my deck to win. Mana is a resource within the trading card game that allows the players to play their other cards. These mana rocks enable the user to produce more mana earlier in the game and see use in a variety of decks. In this project, I look at the cards' effects individually and in categories based on each mana rock's unique drawbacks. There are several different factors to consider when judging each of these mana rocks' effectiveness in the game. First, we discuss general relationships between the kill turn and the number of mana rocks in the deck, my starting hand, and on the battlefield. The kill turn is the turn where I can win the game. We analyze how unique aspects of the individual mana rocks may affect the kill turn. Finally, we examine the effect each mana rock has individually on the kill turn.

2:00 p.m. **Examining Some of the Mathematical Aspects of Gaming**

Richard Kevan & Thomas Krotz, Molloy College
Advisor: Dr. Deborah Upton, Molloy College

Mathematics has applications that extend beyond what is taught in the classroom. In this paper we will talk about some of the applications of mathematics in gaming. The first topic of focus is how probability determines the events of board games and tabletop games such as Dungeons and Dragons. The second application that will be discussed is how series are used by speedrunners to create the fastest runs possible for games like Castlevania or Super Mario. Lastly, we will discuss the algorithms that are used in Pokémon that determine the success or failure of a capture.

2:15 p.m. **Patterns Between the Number of Cevians or Caliians and the Regions That They Form in Polygons**

Calia Kugler, Binghamton University
Advisor: Robert Gerver

This paper is a description of an investigation into cevians and caliians (cevians in a figure other than a triangle). The formula for the number of regions formed in a triangle by drawing n cevians from each vertex is obtained in several ways. Next, formulas for the number of regions formed in other simple polygons by drawing n caliians are developed. A pattern is observed and a general formula for the number of regions in any polygon is developed. This formula is then generalized to show the number of regions formed in a simple polygon by drawing caliians not only to the opposite side of a vertex but to other sides as well. A java program is developed to count the number of regions in a triangle and a square formed by any number of cevians or caliians drawn from any vertex, thus not requiring the same number of cevians or caliians from each vertex. The formula for the number of regions in any simple polygon formed by drawing

any number of cevians or caliians from any vertex to any side is developed. The general formula is then proved using mathematical induction.

2:30 p.m. The Muffin Man? No, the Gingerbread Man. A Visual Representation of Difference Equations

Kelsey Burke & Malaya Green, Molloy College
Advisor: Dr. Deborah Upton, Molloy College

The Gingerbread Man Map is not referencing a cookie, but rather a system of difference equations within the area of dynamical systems. We will break down the work by Wirot Tikjha, Yongwimon Lenbury, and Evelina G. Lapierre to provide a better understanding of how to analyze and solve a system of difference equations, which was motivated by the original Gingerbread Man Map. We aim to provide a comprehension of difference equations that scrapes the surface of their capabilities and bring forth a visual representation of how a piecewise system of linear difference equations functions. We will discuss specific aspects of this system presented and supply concrete examples of how this system behaves depending on its location in the coordinate plane. Our ultimate goal is to provide a different way to look at difference equations through visualization and specified examples that may help others learn the topic better — for example, for students in a math modeling course or differential equations course that are taught the topic in a general way.

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METROPOLITAN NEW YORK SECTION OF THE MAA
TREASURER'S REPORT

ASSETS	BALANCE 05/01/20	BALANCE 04/30/21
Chase Business Classic	$5,500.51	$8,352.25
Chase Business Select High Yield Savings	$13,089.39	$13,091.24
NY Metro Section Total Assets	$18,589.90	$21,443.49

CHASE BUSINESS SELECT HIGH YIELD SAVINGS (0366)

Credits

Date	Description	Amount
05/01/20-04/30/21	Interest (does not include 4/30)	$1.85
Total Credits		**$1.85**

CHASE BUSINESS CLASSIC CHECKING (0365)

Deposits/Credits

Check #	Date	Description	Amount
	09/11/20	Janet Liou-Mark Scholarship Fund donation	$2,000.00
	10/14/20	Annual Meeting registration (cash)	$510.00
	02/16/21	Subvention Credit	$1,195.00
Total Credits			**$3,705.00**

Checks Paid/Debits

#	Date	Description	Amount
950	05/03/20	Boyan Kostadinov (zoom conference license)	$14.99
951	06/16/20	Max D. Wakefield (Annual Meeting keynote speaker)	$300.00
	10/14/20	Annual Meeting PayPal fees	$28.07
952	11/09/20	Abraham Mantell (plaques for 2020 award winners)	$520.20
Total Debits			$853.26

JANET LIOU-MARK SCHOLARSHIP FUND

Deposits/Credits			
	Date	**Description**	**Amount**
	9/11/20	Donation (Janet Liou-Mark)	$2,000.00
Total Credits			**$2,000.00**

GRAPH THEORY DAY FUND (CONTAINED WITHIN 0365)

Deposits/Credits			
	Date	**Description**	**Amount**
Total Credits			
Checks Paid/Debits			
Check #	**Date**	**Description**	**Amount**
Total Debits			
		BALANCE	**BALANCE**
		05/01/20	**04/30/21**
Graph Theory Day Fund		**$2,172.41**	**$2,172.41**

MAA METRO NY CONFERENCE

May 1, 2021

INVITED SPEAKERS

Jacqueline Jensen-Vallin, Lamar University & Editor of MAA Focus

Melvyn B. Nathanson, Lehman College and CUNY Graduate Center

LIST OF PRESENTERS

Institution	Faculty Presenter	Student Presenter
Adelphi University	Joshua Paul Hiller	Francesca Amato
	Monica Morales	Michelle Zhang
		Daniel Delasherasgarcia
		Andrew Velasquezber
		Chante Parker
		Christopher Benson
Ball State University	José Contreras	
Bergen County Academies and Juilliard Pre-College		Cadee Lee
Binghamton University		Calia Kugler
Biostat Software Development	Paul Johnson	
Boston College		Udayan Mahanty
Brooklyn Technical High School		Maciej Obrebski
California State University San Marcos	Marshall Whittlesey	
CUNY, NYCCT	Brad Isaacson	Daanial Ahmad
	Satyanand Singh	Xiaona Zhou
	Lucie Mingla	Olga Privman
	Jonas Reitz	Naved Khan
	Lin Zhou	Sherene Moore
	Ariane Masuda	Shaylin Venitelli
	Nadia Kennedy	Oumou Diallo
	Urmi Ghosh-Dastidar	Ruben Vecino
	Sandie Han	Maria Deleon
	Marianna Bonanome	Xiaoqing Wu
	Katherine Poirier	Lucy Piacentini
		Christal Jean-Soverall
		William Pollicino
		Jake Postiglione

		Allan Emmanuel
		Luc Telemaque
		Violanda Lubani
		Jess Topal
		Silvana Quiroz
		Babacar Dieng
		Myatkwar Thar
		Nicole Torres
		Noor Najam
		Zahra Sharif
		Mamadou Balde
		Caroline Eco
		Oliver Imhans
		Shaun Pollard
		Jose Sanchez
		Jude Vallon
CUNY, BCC		Ana Abreu
		Stance Mason
CUNY, Graduate Center		Hannan Aizenman
CUNY, Hostos Community College	JungHang Lee	
CUNY, City College		Mamadou Balde
		Xiaoqing Wu
		Max Sehaumpai
		Ding Dong LI
CUNY, Lehman College	Chen-Yun Lin	
	Esteban Alcantara	
	Maziar Farahzad	
	Jalinda Pillari	
	Christina Sormani	
CUNY, York College	Donald M Taylor-Bruce	
Davis Senior High School		Caroline Johnson
Fairfield Ludlow High School		Shagun Bothra
Farmingdale State College, SUNY	Svetlana Tlupova	Sebastian Toro
	Alex Kodess	
Fluor	Yozo Mikata	
George W. Hewlett High School		Kira Grossman
Harvard University		Nadine Meister
Hofstra University		Joseph Ronzetti
Iona College	Benjamin Gaines	
Manhattan College		Maxwell Bohling
		Andrew Cirincione
		Parul Rai
Midwood High School		Anthony Nosoff
Molloy College		Kelsey Burke

		Grace Edwards
		Malaya Green
		Richard Kevan
		Angela Sadlis
		Breanna Biancardi
		Vincent Pecora
		Thomas Krotz
Pace University	Shamita Dutta Gupta	
Rowan University	Jay Schiffman	
Saint Peter's University	Rebecca Conley	
St. John's University		Isaac Moorman
		Rainah Khan
St. Joseph's College-Brooklyn		Ana Zikovska
Stuyvesant High School		John Gupta-She
SIMIODE www.simmiode.org	Brian Winkel	
Suffolk County Community College	Alexander Atwood	
	Russell Coe	
University of East Anglia		Matthew Rudy Meangru
Valley Stream Central High School		Najalia Singh
West Point, US Military academy	Caleb Sheffield	
	Mario Andriulli	
	Shane Smith	
	Robert R. Craig	
	James Starling	
	Evangeline M Reynolds	
	Blake Schwartz	
	Lee Evans	
	Tyson Walsh	
USA		Christina Pospisil

Thank you for participating!