# MATH POSIUM

**Nov 15 – 16, 2024**

## Schedule, Abstracts, and Who's Who

Welcome to the Mathposium!
Take a look through abstracts for student talks and visit the *Who's Who?* to learn about presenters, panelists, and plenaries!

We are committed to creating a safe and nurturing community in mathematics and beyond. At UTA, we strictly follow a policy where sexual harassment, other forms of harassment, and sexual assault are completely unwelcome. Harassment or abuse in any form has never and will never be tolerated at the Mathposium. Be a positive bystander and protect yourself and other students in the community by reporting any violation of student conduct to UTA's Title IX office.

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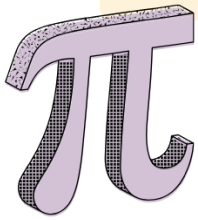
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MATHPOSIUM 2024

# FRIDAY NOV 15TH

| | |
|---|---|
| **10:30am-12pm** | Registration |
| **12-12:15pm** | What to Expect from Mathposium |
| **12:15-1:45pm** | Lunch and Plenary I |
| **1:45-3:15pm** | Poster Session |
| **3:15-3:45pm** | Snack Break |
| **3:45-5pm** | Mentoring Pod Activity |
| **5pm +** | Group Activities and Explore DFW |



All events will be in the SEIR Building at UTA

MATHPOSIUM 2024

# SATURDAY NOV 16TH

| | |
|---|---|
| **8:30-9:30am** | Light Breakfast *(optional)* |
| **9:30-10:30am** | BIG Math Careers Panel |
| **10:30-11am** | Coffee Break |
| **11am-12pm** | Graduate School Panel |
| **12-1:30pm** | Lunch and Plenary II |
| **1:30-2:45pm** | Lightning Talks |
| **2:45- 3pm** | Snack Break |
| **3-4pm** | REUs and Internships Panel |

All events will be in the SEIR Building at UTA

# Presentations

## Poster Session

**November 15th, 1:45 PM – 3:15 PM**

### Failure Analysis of Floating Offshore Wind Farms



*Emma Slack[1], Matthew Hall[2]*
*[1]The University of Texas at Arlington,*
*[2]National Renewable Energy Laboratory, National Wind Technology Center*

Electricity usage in the United States doubled from 2.0 trillion to 4.0 trillion KWh between 1982 and 2022. Although demand has plateaued recently, projections suggest U.S. electricity consumption will continue to increase alongside demands for alternate energy resources. Offshore wind technology may bridge the gap between current and future energy needs. Existing fixed-bottom farms produce about half the energy that floating offshore farms do. With a single floating turbine producing 78 million KWh of electricity annually (enough to power 25,000 homes), floating offshore turbines offer a promising solution. To provide farms with maximum productivity, the National Renewable Energy Laboratory is designing floating offshore farms with minimal malfunctions. Yet little is known about the interdependence of multiple turbines. In this project, we analyzed how mechanical failures spread between floating offshore wind turbines. We started with tables from industry experts detailing what happens when a component fails: specifically which other components may fail as a result. Combined, these tables formed directed networks (i.e. mathematical depictions of cause-and-effect). Using a computer program that traces the effects of one component failing, we found the progression of turbine failure. We used this progression and published failure rates to calculate the average probability that one component failing will cause another component to fail. We found that the average probabilities of a turbine component causing a failure in a separate turbine and the same turbine are 8.42% and 20.91%, respectively. Thus, it appears that offshore wind farms are more susceptible to inner-turbine failure than inter-turbine failure. Future work will add complexity to the model via material specification.

### How to start a Professional Learning Community: A Literature Review and Research Opportunities



*Sundas Hussain[1], Theresa Jorgensen[1], Michelle Maher[2], Jacob Marszalek[2], Camilla Morone[3], Leen-Kiat Soh[3]*
*[1]The University of Texas at Arlington, [2]University of Missouri-Kansas City,*
*[3]University of Nebraska-Lincoln*

A professional learning community (PLC) is a group of professionals that shares ideas to improve practice and creates an inclusive environment (Serviss, 2022). However, obstacles to successful implementation, such as stakeholder resistance, budgetary policies, and turnover are common (Bolam et al., 2005). Our purpose was to review the literature on starting a PLC to inform our own formation of PLCs in the PROSPECT S-STEM Research Hub.

We reviewed 20 articles and identified 18 definitions of a PLC, 33 reported benefits, 47 stakeholder types, and 118 steps in starting a PLC. We grouped steps into 11 themes: leadership, vision, collaboration, support, goals, share, focus, commitment, culture, data driven, and other. These steps shape the creation and development of a PLC, and are typically cyclical and evolving. For the PROSPECT project, one of our goals is to "tell the story" of the PLCs in the S-STEM partnerships between associates-granting and bachelor-granting institutions that we are studying. We found that most S-STEM partnerships did not identify themselves as having PLCs as a component of their partnership. However, after completing site visits of some of these partnerships, there was clear evidence of PLCs via the above 11 themes.

Bolam R., McMahon A., Stoll L., Thomas S., Wallace M. (2005). Creating and sustaining effective professional learning communities (DfES Research Report RR637). University of Bristol.
Serviss, J. (2022, May 13). 4 benefits of an active professional learning community.

### A SIMPL Model of Phage-Bacteria Interactions



*Carli Peterson[1], Darsh Gandhi[1], Austin Carlson[1], Emma Richardson[1], Aaron Lubkemann[1], John E Serralta[2], Michael S Allen[2], Souvik Roy[1], Christopher Kribs[1], Hristo Kojouharov[1]*
*[1]The University of Texas at Arlington*
*[2]The University of North Texas Health Science Center at Fort Worth*

*Pseudomonas aeruginosa* is an opportunistically pathogenic bacteria that causes fatal infections and epidemics in hospital environments. Due to the growing prevalence of antibiotic-resistant strains of *P. aeruginosa*, looking for alternative therapies is crucial. Bacteriophage therapy is emerging as a promising solution; however, it has not been approved for human clinical use and suffers from a lack of understanding of the complex dynamics between bacterial cells and phage virions. Mathematical models provide insight into these dynamics. Through a system of ordinary differential equations, we determined appropriate biological assumptions to effectively capture the complex dynamics observed between susceptible, infected, and mutated bacterial cells with bacteriophage virions in a microwell setting. Data fitting based on this model produced a set of parameter estimates unique to our experimental observations of a specific phage and *P. aeruginosa* strain. In translating observed optical density readings into bacterial concentrations, we also found that bacterial debris has a significant impact on optical density, with a lysed bacterium contributing roughly $40\%$ as much to optical density readings as a living cell.

### Generating Vascular Models and Assessing Uncertainty in Medical Images



*Darsh Gandhi[1], Alexandria Johnson[2], Emma Slack[1], Isaiah Stevens[2], Zachary Turner[3], Michelle Bartolo[4,5], Mette Olufsen[2]*
*[1]The University of Texas at Arlington, [2]North Carolina State University, [3]Duke University, [4]Broad Institute of MIT and Harvard, [5]Massachusetts Eye and Ear*

One-dimensional (1D) cardiovascular models offer a non-invasive method to answer medical questions, including predictions of wave-reflection, shear stress, fractional flow reserve, vascular resistance, and compliance. This model type can predict patient-specific outcomes by solving 1D fluid dynamics equations in geometric networks extracted from medical images. However, the inherent uncertainty in in-vivo imaging introduces variability in network size and vessel dimensions, affecting hemodynamic predictions. Understanding the influence of variation in image-derived properties is essential to assess the fidelity of model predictions. Numerous programs exist to render three-dimensional surfaces and construct vessel centerlines. Still, there is no exact way to generate vascular trees from the centerlines while accounting for uncertainty in data. This study introduces an innovative framework employing statistical change point analysis to generate labeled trees that encode vessel dimensions and their associated uncertainty from medical images. To test this framework, we explore the impact of uncertainty in 1D hemodynamic predictions in a systemic and pulmonary arterial network. Simulations explore hemodynamic variations resulting from changes in vessel dimensions and segmentation; the latter is achieved by analyzing multiple segmentations of the same images. Results demonstrate the importance of accurately defining vessel radii and lengths when generating high-fidelity patient-specific hemodynamics models.

### N-body Modeling of the Left Atrium Accelerated on NVIDIA GPUs

*Kyla Moore[1], Leah Rogers[1], Mason Bane[1]*
*[1]Tarleton State University*

Heart disease and stroke are the leading causes of death worldwide, with atrial arrhythmias significantly contributing to these conditions. Catheter ablation is the safest and most effective treatment for recurrent arrhythmias; however, there is still limited understanding of their causes and optimal ablation strategies, making the process both an art and a science. To address these challenges, we have developed an interactive digital twin of the left atrium, the heart's most complex chamber where most arrhythmias originate. This model allows researchers to simulate conditions that trigger arrhythmias and test ablation strategies outside the operating room. By adjusting specific muscle strand attributes, they can explore how arrhythmias emerge and determine effective lesion placements. The computationally intensive components of the model were written in parallel and offloaded to NVIDIA GPUs for acceleration.

### Using Bayesian Methods to Improve Single Point Estimates for ODE Models of Disease Spread

*Kyle Earp*[1], *Jano Scott*[1]
[1] *Tarleton State University*

Classical models of disease outbreaks rely on systems of nonlinear ordinary differential equations. ODE models have been widely successful and are credited with saving millions of lives worldwide. However, ODE models involve parameters that are often poorly understood and difficult to infer from limited and noisy data. This is especially problematic for rare, novel, or neglected diseases with unreliable reporting mechanisms. While some parameters can be deduced from biological or social facts, many must be inferred from data. Traditional least-squares point-estimates are fragile when applied to noisy data common in disease modeling. Bayesian inference replaces fragile point-estimates with posterior distributions that are more robust against data quality issues. Whereas point-estimate models produce a single outbreak forecast, Bayesian models generate an ensemble of forecasts through repeatedly sampling model parameters from their posterior distributions and numerically solving the resulting ODE. These multiple forecasts can be pooled and statistically analyzed at each time step (min, max, mean, etc) to give insight into potential outbreak scenarios (best-case, worst-case, most likely, resp). Additionally, there might exist different parameter sets that produce similar least-squares values. In these cases it can be unclear what the most correct parameter set is. By using prior distributions that include these single point-estimates, we can allow Bayesian methods to determine the most likely values for unknown parameters by analyzing the posterior distributions generated by the Bayesian model. This project aims to create well-functioning ODE models using a new mathematical idea called amortized Bayesian inference implemented in the BayesFlow Python library. This exciting new tool was created in 2020 to help fight Covid-19 and other common diseases. This project will enhance the BayesFlow library to compensate for data quality issues and provide the improved models epidemiologists need to effectively fight NTDs, and develop techniques for handling systems where single point-estimates are not unique.

### N-Body Simulations of Microplastic Removal Using Polymers



*Shelby Clingan*[1], *Ethan Conner*[1], *Mason Bane*[1], *Marconi Azadah*[1], *Christopher Mitchell*[1], *Bryant Wyatt*[1], *Rajani Srinivasan*[1]
[1] *Tarleton State University*

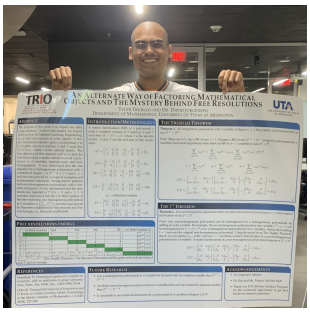
Microplastics, defined as plastic particles ranging from 100 $\mu$m to 5 mm, have emerged as a significant environmental pollutant, contaminating numerous ecosystems. These particles have been detected in almost every water supply and the vast majority of food products. They pose serious ecological challenges in these environments, necessitating effective removal strategies. This study focuses on their accumulation and removal from aquatic bodies. One promising approach involves the use of naturally occurring polymers, specifically polysaccharides, derived from sources such as fenugreek seeds, okra, and cactus. These polymers will adhere to microplastics present in environmental water samples, creating large flocs, or loosely clumped masses of fine particles, that can be easily removed. This project aims to develop a mathematical model to simulate the microplastic extraction process. An N-body simulation has been created to model the interactions and movements of microplastics and polymer chains within a water sample. The results from this simulation will be used to predict the amount of polymers required to effectively remove a given concentration of microplastic pollutants in a water sample.

### On Weyl Representations of $\mathfrak{gl}(n)$

*Amairani Hernandez-Garcia*[1]
[1] *The University of Texas at Arlington*

In this poster we introduce module $P_\mu$ and prove it's indecomposability. First, we discuss the case of $\mathfrak{gl}(n)$ for $n = 3$, $n = 4$ and prove important properties in regard to their submodules, quotients, and socle filtration. Finally, we generalize such results for any $n \geq 3$.

### An Alternate Way of Factoring Mathematical Objects and The Mystery Behind Free Resolutions



*Tyler Trujillo*[1], *David Jorgensen*[1]
[1] *The University of Texas at Arlington*

The purpose of this work is to impact any field using matrices. I believe this project can impact fields such as AI, Machine Learning, engineering, etc. as they use matrices in every aspect. A matrix factorization breaks apart a polynomial $p$ in $d$ variables into two matrices $S$ and $T$ such that $ST = TS = pI$, where $I$ is the identity matrix. The first objective of this research will be to find the size required for a matrix factorization of a polynomial in $d$ variables, homogeneous and non-homogeneous. It was discovered that the size required for a homogeneous polynomial with $d$ variables of degree $n$ is $2^{d-1}$ if $n \in \mathbb{N}$ and $n \geq 2$ and this was proved by a series of examples and mathematical induction. Seeing similar patterns with non-homogeneous polynomials with $d$ variables of degree $n$ it was determined that the size required is $2^d$ if $n \in \mathbb{N}$ and $n \geq 2$. It was also discovered that the $nth$ Betti number of the free resolution of a homogeneous polynomial in $d$ variables is $\sum_{i=0}^{n} \binom{d-1}{i}$, and this was proven by theorems established in this paper and Pascal's triangle, i.e., binomial coefficients.

### Exploring the Potential of Using ECT on LFP Recordings from Rats' Brains to Treat Migraines



*Khitam Aqel*[1], *Julieta Trejo*[1], *Yuan B Peng*[1], *Pedro D Maia*[1]
[1] *The University of Texas at Arlington*

The study used high-resolution electrophysiological recordings to investigate how the rat brain processes and modulates pain. The research involved several stages, including recording brain activity at rest, inducing acute pain using formalin, and applying electroconvulsive therapy (ECT) at different strengths. Neural activity was recorded at a rate of 3 kHz from four different brain regions over a period of 70 minutes. The researchers used the Eigensystem Realization Algorithm (ERA) to analyze the extensive dataset. This analysis provided insights into the timing and location of pain-related brain responses and how they were affected by ECT. The findings shed light on how nociceptive signals, central pain processing, and the effects of ECT interact, offering potential guidance for future pain management strategies.

### Self-Tor Persistence of Modules over Determinantal Rings



*Tatheer Ajani*[1]
[1] *The University of Texas at Arlington*

Tor-persistence is the claim that Tor of a module with itself is only zero if the module has finite projective dimension. Work done by Avramov, Iyengar, Nasseh, Sather-Wagstaff, and various other authors have proven modules over certain rings are Tor-persistent. In this work, we study Tor-persistence for the generic module over determinantal rings, specifically for the hypersurface R defined by the determinant of a generic matrix. We give an explicit proof that $Tor_2^R(M, M)$ is never zero, where M is the cokernel of the generic matrix. We will also discuss the more general determinantal rings, as well as different specializations.

### Bayesian Networks: With Applications for Analyzing Causal Relationships in Rice



*Jared Richardson*[1], *Shannon Pinson*[2], *Jeremy Edwards*[2]
[1] *The University of Texas at Arlington,* [2] *Dale Bumpers National Rice Research Center*

This collaborative study leverages data-driven agriculture and computational tools to predict causal relationships among rice traits under various growing conditions. Utilizing a combination of multi-omic datasets, we developed unique mixed models for the calculations of Best Linear Unbiased Predictors (BLUPs) and employed Bayesian Networks for the construction of Directed Acyclic Graphs (DAGs). By integrating these datasets with additional single nucleotide polymorphism (SNP) data, we created probabilistic graphical models that illustrate relationships between traits and genetic SNP markers. These findings potentially provide valuable insights for plant pathology and agronomy, with implications for optimizing growing conditions and enhancing our understanding of genomic-trait interactions.

### On Field Soil Carbon Measurement

Jose Cortes[1], Andrzej Korzeniowski[1], Galina Yakubova[2], Aleksandr Kavetskiy[2], Allen Tober[2]
[1]The University of Texas at Arlington, [2]USDA-ARS Auburn Lab



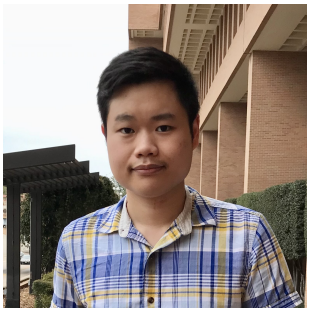
A novel on-field measurement device and the applied mathematics of its development and analysis. Including MC simulation of traditional core sampling analysis method, MC Neutron Particle simulation and Analysis for novel method. Built at the USDA lab in auburn, the device is named the "MINS System" for Mobile Inelastic Neutron Scattering. The machine leverages neutron interactions to measure chemicals in soil such as carbon. The on site tool is a time and cost saving alternative to lab analysis.

### Advancing Multivariate Functional Regression Models with Machine Learning: Integrating Error-Measurements in Covariates to Reveal Statistically Significant Factors Affecting Infant Mortality Rate

Mishu Devadasan[1], Will Chen[1], Shan Sun-Mitchell[1], Gabriela Wilson[1], Mari Tietze[1]
[1]The University of Texas at Arlington



This study investigates neonatal mortality in Texas, using multivariate functional regression models and machine learning to assess the impact of socioeconomic and clinical factors. Combining data from the Texas Health Care Information Council (THCIC) and social indicators from UTA's Policy Map, the dataset includes 367,381 records on patient demographics, health outcomes, and socioeconomic conditions. Testing six hypotheses on factors like poverty, single-parent households, education, and access to transportation, the study reveals significant links with neonatal mortality. Key predictors, including low birth weight and respiratory arrest, underscore the role of insufficient prenatal care. These findings highlight the need for targeted public health efforts to reduce neonatal health disparities in Texas.



### A Comparative Study of Deep Reinforcement Learning for Crop Production Management

Joseph Balderas[1], Dong Chen[2], Yanbo Huang[2,3], Li Wang[1], Ren-Cang Li[1]
[1]The University of Texas at Arlington, [2]Mississippi State University, [3]USDA-ARS



Crop production management is essential for optimizing yield and minimizing a field's environmental impact, yet it remains challenging due to the complex stochastic processes involved. Recently, researchers have turned to machine learning to address these complexities. Specifically, reinforcement learning (RL), a cutting-edge approach designed to learn optimal decision-making strategies through trial and error in dynamic environments, has emerged as a promising tool for developing adaptive crop management policies. RL models aim to optimize long-term rewards by continuously interacting with the environment, making them well-suited for tackling the uncertainties and variability inherent in crop management. Studies have shown that RL can generate crop management policies that compete with, and even outperform, expert-designed policies within simulation-based crop models. In the gym-DSSAT crop model environment, one of the most widely used simulators for crop management, proximal policy optimization (PPO) and deep Q-networks (DQN) have shown promising results. However, these methods have not yet been systematically evaluated under identical conditions. In this study, we evaluated PPO and DQN against static baseline policies across three different RL tasks provided by the gym-DSSAT environment: fertilization, irrigation, and mixed management. To ensure a fair comparison, we used consistent default parameters, identical reward functions, and the same environment settings. Our results indicate that PPO outperforms DQN in fertilization and irrigation tasks, while DQN excels in the mixed management task.

### The Inverse of the Integer Knapsack Problem

*Shammas Ahmed*[1]
[1]*Rice University*




Given a (forward) optimization problem $P$ and a feasible solution $x^\circ$, the *inverse-feasible region* is the set of objective vectors under which $x^\circ$ is optimal to $P$. The *inverse optimization problem* finds an inverse-feasible vector that is closest under $L_1$ norm to the original objective vector of $P$. In this project, we analyze the inverse of integer knapsack problem (IKP) and its inverse feasible region. Assuming that all extreme points of the linear programming (LP) relaxation of IKP (where the integrality of decision variables is relaxed) are feasible for IKP, we present some structural properties of the inverse feasible region of IKP for a feasible solution $x^\circ$, denoted by $IFR(\text{IKP}, x^\circ)$. When $x^\circ$ is an extreme point, we show $IFR(\text{IKP}, x^\circ)$ contains $\mathbf{0}$ and some other regions of $\mathbb{R}^n$; for any two distinct extreme points, $x_1$ and $x_2$, $IFR(\text{IKP}, x_1)$ and $IFR(\text{IKP}, x_2)$ do not overlap, except possibly in the boundary. When $x^\circ$ is not an extreme point, we show $IFR(\text{IKP}, x^\circ)$ is the intersecting region of the inverse feasible regions of a subset of extreme points. Future work may include investigating the superadditive duality of IKP and find an LP formulation for the inverse of IKP.

### The Koszul Homology of Minimal Intersection Rings

*Katie Grebel*[1]
[1]*The University of Texas at Arlington*



The Koszul homology of a local ring is a powerful tool in commutative algebra as it provides information on the structure and properties of the ring. In this research, we explore the relationship between quotient rings and their Koszul homology. One such relationship is detailed by the Tate-Assmus Theorem, which asserts that a ring is a complete intersection if and only if the Koszul homology is generated by its degree 1 homology elements. An objective of this research is to produce a similar result to the Tate-Assmus Theorem in terms of a minimal intersection. We start by showing behaviors of the Koszul homology when the underlying ring is a minimal intersection. In particular, we show that the Koszul homology of a minimal intersection ring decomposes as the tensor product of two subalgebras.

### Introduction to a Family of Shallow Water Waves

*Christina Martinez*[1]
[1]*The University of Texas at Arlington*

Nonlinear dispersive partial differential equations have a wide range of applications primary used to model phenomena such as wave propagation. Water waves is a particular case of this phenomena and of great importance in fluid dynamics, ocean studies, and mathematics. One type of water wave that hold great importance is known as a shallow water wave. The objective of this research is to present a mathematical description of shallow water waves, provide one- and two-dimensional examples of these water waves, and derive a family of shallow water wave equations. Determining exact solutions for nonlinear partial differential equations is challenging; this presentation concludes with introducing techniques to analyze properties of these equations.

**Attentional System Features as Predictors of WISC Subtest Outcomes: a Machine Learning Study**




*Rodina Eladawy*[1], *Pedro Maia*[1]

[1] *The University of Texas at Arlington*

This study investigates the predictive potential of attentional system features, including pupil dilation dynamics and reaction time variability, to estimate cognitive outcomes on the Wechsler Intelligence Scale for Children (WISC-III) in children with attention-deficit/hyperactivity disorder (ADHD). Using a dataset of visuospatial working memory assessments, we employ machine learning models to explore how neurophysiological metrics relate to traditional intelligence subtests. Applying tsfresh for extensive feature extraction and multiple regression techniques, we evaluate both behavioral-demographic (B&D) and pupil-derived (PD) features across different WISC subtests. The results indicate that pupil-derived features, in combination with behavioral-demographic variables, provide robust predictive accuracy across cognitive domains, particularly for Verbal IQ (VIQ), Perceptual Organization (PO), and Vocabulary (V) subtests. Specifically, ElasticNet and Support Vector Regressors yielded significant models for Verbal Comprehension (VC) and Symbol Search (SS), while Gradient Boosting was optimal for Full Scale IQ (FSIQ) and Processing Speed (PS). This research demonstrates that attentional system markers can serve as non-invasive, physiologically-based predictors of cognitive functioning, advancing the field of neuroscience-driven intelligence assessment and offering insights for ADHD diagnostics and interventions.

**Dissecting Merten's Conjecture: Flux Integrals, Vector Calculus**



*Kamiah Long*[1]

[1] *East Texas A&M University*

Mertens function $M(n)$ is commonly misunderstood and underrepresented in the mathematical profession. This function is not a theorem, but rather a corollary. Contrary to the twin prime conjecture, this uncommon function was disproven in 1985. Therefore, this research investigates the process of the disproof of Mertens function and its connection to the Riemann hypothesis.

## Lightning Talks

**November 16th, 1:30 – 2:45 PM**

### The Dicrotic Notch: What We Can Learn from Fourier Analysis



*Ayden Edwards*[1], *Dipanwita Bose*[1], *Charles Edward Puelz*[1]
[1] *University of Houston*

When graphing blood pressure in the cardiovascular system as a function of time, a strange cusp appears after the end of the downstroke of the heart. This cusp is known as the dicrotic notch. Much assertions have been made about the origin of the dicrotic notch, but literature suggests the cause is unclear. When graphed, this pressure can be represented periodically, allowing for an analysis using a Fourier series representations. It is also helpful to consider Wavelet Transforms for heartbeats, a more localized form of Fourier Transforms, helpful for signals with inconsistent frequencies. These analyses enable easier detection of the dicrotic notch, which is helpful in diagnostics and medicine research.

### N-body Modeling of the Left Atrium Accelerated on NVIDIA GPUs

*Kyla Moore*[1], *Leah Rogers*[1], *Mason Bane*[1]
[1] *Tarleton State University*

Heart disease and stroke are the leading causes of death worldwide, with atrial arrhythmias significantly contributing to these conditions. Catheter ablation is the safest and most effective treatment for recurrent arrhythmias; however, there is still limited understanding of their causes and optimal ablation strategies, making the process both an art and a science. To address these challenges, we have developed an interactive digital twin of the left atrium, the heart's most complex chamber where most arrhythmias originate. This model allows researchers to simulate conditions that trigger arrhythmias and test ablation strategies outside the operating room. By adjusting specific muscle strand attributes, they can explore how arrhythmias emerge and determine effective lesion placements. The computationally intensive components of the model were written in parallel and offloaded to NVIDIA GPUs for acceleration.

### A data envelopment analysis of community college students continuing their education

*Archer Goodwyn*[1], *Ryan Stedman*[1], *Ivan Ojeda-Ruiz*[2], *Xiaowen Cui*[1]
[1] *Austin Community College,* [2] *Texas State University*

We are studying the factors that are most significant in determining which students go on to continue their education at a four year university after attending Austin Community College. We plan to do this by performing a data envelopment analysis on a set of demographic data about transfer students.

### The Math Behind Hispanic students and Higher Education



*Jacqueline Medrano*[1], *Enrique Ramirez*[1], *Ivan Ojeda-Ruiz*[1]
[1] *Texas State University*

We are currently researching a topic in relation to students and their pathway to graduate programs. Did you know that in Texas State, around 40% of the student population is Hispanic, while around 3.9 of the overall faculty demographics is Hispanic... We are trying to shine light on the contributing factors that are preventing the Hispanic demographic from continuing their studies after their undergraduate. We plan to achieve this by analyzing current/modern data to determine which factors contribute the most in the student's pathway to graduate programs. We hope that once determined, our data will help universities when creating seminars to help their students in their studies.

We plan to study which factors are most significant in determining which students go on to continue their education at a four year university after attending a community college. We plan to do this by performing a data envelopment analysis on a set of demographic data about transfer students.

### The Counting Formula for Cubic Maps

*Austin Brown*[1]
[1] *The University of Texas at Arlington*

Proposed by Francis Guthrie in 1852, one question stumped mathematicians for over a century: can every planar cubic map be colored with a minimum of four colors? This was the Four Color Problem, and as of 1976 it has been "solved."

One important step in solving this problem was through relating faces, edges, and vertices in order to generalize almost every constructable cubic map as colorable. This integral relationship is known as the counting formula for cubic maps, the catalyst towards our solution of the Four Color Problem and the object of this lightning presentation.

**Beyond autism diagnostics: ranking fMRI regional time series by compressibility using autoencoders**



*Jason Bard*[1], *Pedro Maia*[1]
[1] *The University of Texas at Arlington*

The use of deep learning, particularly autoencoders (AE), for diagnosing autism spectrum disorder (ASD) from functional magnetic resonance imaging (fMRI) data is well-established in the literature. Numerous studies have explored the extraction of features from fMRI time series data to train neural networks or other machine learning models aimed at diagnosing ASD, often integrating these models with additional clinical features. An autoencoder's compressibility refers to how well it can reduce the dimensionality of the input while still retaining essential information. In this study, we significantly depart from the traditional ASD diagnostic focus using AE or other deep learning architectures with fMRI data. Instead, we aim to explore the intrinsic complexities within the time series collected from various brain regions in both ASD and control groups. We seek to rank each brain region based on how well its corresponding fMRI time series can be compressed using different types of autoencoders. Our ranking will be derived from an interpositional formula that balances both the compression ratio achieved by each autoencoder and the associated reconstruction error, providing a comparative analysis of brain region compressibility between ASD and healthy subjects. We intend to do this according to a novel formulaic quantification: the biologically constrained compressibility (BCC) and the unconstrained compressibility (UC) of each brain region's autoencoder family. Furthermore, we intend to relate these rankings with the hypoactivity and/or hyperactivity of these brain regions. We propose that hypoactive brain regions may have a higher BCC, whereas hyperactive brain regions have a lower BCC. In addition, we plan to introduce a form of biological interposition into our autoencoder, using a formula that interposes several hidden layers between our input and our latent space. The number of layers and the number of neurons within each layer will be determined by the relative size of the brain region.

**Automated Parameter Estimation in a Three-population Neuronal Network from Recorded Sleep Hypnograms**



*Shreshtha Chaturvedi*[1], *Pedro Maia*[1], *Souvik Roy*[1]
[1] *The University of Texas at Arlington*

Understanding the emergence of cyclical patterns in biological neuronal networks is crucial for gaining insights into sleep mechanisms and sleep-related disorders. This work explores a dynamical system of coupled nonlinear ordinary differential equations (ODE) that models the interactions among three distinct neuronal populations. Although direct measurements of their firing rates are typically unavailable, tracking the dominant population over time produces stage transition patterns resembling those observed in sleep hypnograms. We develop an automated parameter estimation method for this model using a smoothed winner-takes-all strategy based on neuronal firing rates. The approach formulates a constrained minimization problem, which is converted into an unconstrained one via the Lagrangian. The optimality system is derived from state equations, adjoint equations, and optimality conditions. To infer the unknown ODE parameters numerically, we implemented a projected nonlinear conjugate gradient scheme. We validated our framework by achieving successful reconstructions for 111 out of 139 hypnograms curated from the Sleep-EDF database at PhysioNet. Ultimately, the inferred parameters capture key characteristics of the neuronal populations governing sleep dynamics, including interaction strengths, timescale constants, and the variability in NREM-promoting neurons. These parameters, which cannot be directly obtained from hypnograms, may offer significant insights into the mechanisms of sleep generation, the nature of sleep disorders, and the effects of pharmacological agents on sleep dynamics.

**Generalizing Excess Image Area Under Holomorphic Functions on an Annulus**

*Jonathan Enright*[1], *Mehmet Celik*[1]

[1]*East Texas A&M University*



J. D'Angelo, in his book "Hermitian Analysis", defined and precisely calculated a quantity that determines the amount by which the excess image area of the unit disk under $(z \cdot h)$ surpasses $h$ for a certain class of holomorphic function h. The project aims to observe the area difference between the images of an annulus under $h$ and $h$ multiplied by multipliers such as z and $z^{-1}$. The $L^2$-norm of $h$ and the $l_2$-norm of the Laurent coefficients of $h$ will be used to calculate the area difference. Green's theorem will be applied to move the calculations to the boundary of the annulus, taking advantage of the domain's geometry. Finally, the multiplier $z$ will be replaced with meromorphic rational functions that have zeros in the smaller circle of the annulus to observe the area difference.

# Who's Who?

## Meet the Presenters

In this section, learn more about our poster and lightning talk presenters. Feel free to contact them with questions, feedback, or even proposals to collaborate! Presenters at the Mathposium hail from a variety of backgrounds from around the world, but are united in their passion for math and commitment to the scientific community. They vary from undergraduate freshmen who are just getting started to PhD candidates about to defend their dissertations!

Presenters with a blue 'M' next to their names will be mentors for the upcoming Grad2Undergrad mentoring cohort. This is a unique opportunity for undergraduate students (mentees) to find mentors in graduate students (mentors). The mentor-mentee partners (M&Ms) meet throughout the semester to discuss experiences in math and STEM. They talk about career paths, choosing classes, and getting involved with research projects among other concerns mentees may have. The M&Ms promote wellness and stress relief and work-school-life balance. Outside of meeting with their mentors, Grad2Undergrad mentees will also meet multiple times with their cohort. These meetings give a chance for undergrads to bond with peers at their level and meet the rest of the graduate mentors. They also focus on overarching topics and issues that students face. Many of the Mathposium presenters this year will be Grad2Undergrad mentors for the upcoming cohort - please reach out to them if their story, research, or interests resonate with you!

## Amairani "Mai" Hernandez-Garcia

*PhD Candidate, University of Texas at Arlington*

My name is Amairani (I go by Mai), I was born and raised in Guanajuato, Mexico. I'm interested in Lie Algebra and I'm currently a PhD candidate working under the supervision of Dr. Dimitar Grantcharov on Weyl Representations of gl(n).

## Archer Goodwyn

*Undergraduate Student, Austin Community College*

My name is Archer Goodwyn, and I am a current student majoring in Math at Austin Community College who plans to transfer to UT Austin next year. I previously attended Bard College at Simon's Rock, in Massachusetts before the pandemic.

## Austin Brown

*Undergraduate Student, University of Texas at Arlington*

My name is Austin Brown and I am a second-year pure math undergrad at UTA. I plan on becoming a research mathematician, and although I do not have many clues into what field I would research in, I'm hoping to have plenty of time within these next two years in order to learn about polytopes and eventually make a contribution.

## Ayden Edwards

*Undergraduate Student, University of Houston*



Hi! I'm Ayden Edwards, and undergrad in Computer Engineering, and soon to be Mathematics when I have the chance to declare my second degree. I'm interested in analysis and differential equations, I really love the beauty of the two. I am a freshman, though, so I'm still exploring my career paths. My biggest hobby is leisurely problem solving in math. I hope to pursue significant research in mathematics some day, and teach at a university. I'm super blessed with this opportunity, and I look forward to meeting some awesome people! Aside from math, I really enjoy messing with computers, soccer, and American football. Unfortunately for the latter two hobbies, the teams aren't too great where I live.

Contact: *https://www.linkedin.com/in/aydendeanedwards/*



## Carli Peterson (M)

*PhD Student, University of Texas at Arlington*

Hello! My name is Carli Peterson. I am a second year PhD student at UTA. I received my BS in mathematics from UT at San Antonio in 2022. While I didn't have a strong interest in biology during undergrad, being part of the NSF funded Mathematics for Human Health program at UTA has opened me up to a wide assortment of different applications in mathematical biology. My current research is in Lyme disease transmission modeling. Aside from doing math problems, I enjoy reading, doing puzzles, and binging Netflix series.

Contact: *https://carlipeterson-math.owlstown.net/*

## Christina Martinez

*PhD Candidate, University of Texas at Arlington*

Christina is a fifth year PhD student at the University of Texas at Arlington. Her mathematical interests lie in partial differential equations and applied mathematics. Outside of her math interests, she enjoys skipping rope, watching baseball games, drinking coffee, and spending time with her family and friends.

## Darsh Gandhi

*Undergraduate Student, University of Texas at Arlington*



Hi! I'm a senior math major at UTA focused on applications of math to medicine and numerical methods for differential equations. I love to lead outreach projects to improve career outcomes for math students, combat math anxiety, and promote community amongst mathematicians! Over the past three years, I've started this conference, was two-term president of the UTA MAA chapter, founded our Math Bio Club, and moderated, organized, and served on multiple panels, discussions, and talks about education and community in STEM. Outside of math, I enjoy traveling and exploring, making playlists, and pranking my sister. In the future, I plan on going to grad school and also getting my private pilot's license! *Also, I am looking to take on two undergraduate mentees in the upcoming spring semester - please reach out if you're interested!*

Contact: *https://darshgandhi.owlstown.net/, gandhi.darsh03@gmail.com*



## Emma Slack

*PhD Student, University of Texas at Arlington*

Hi! My name is Emma. I am a first year PhD student and NSF RTG scholar at the University of Texas at Arlington. Last year, I graduated from Colorado State University with my B.S. in mathematics and worked as an intern at the National Renewable Energy Laboratory. My research interests are in graph theory, linear algebra, and mathematical biology. I hope to stay in academia and teach while conducting research, but I am also open to going into industry. In my free time, I enjoy reading, knitting, and exploring new places. If you are attending the Mathposium, please swing by my poster and say 'hi!' I would love to meet you!

Contact: *https://emmaslack-math.owlstown.net/*

## Enrique Ramirez

*Undergraduate Student, Texas State University*



I am Enrique Ramirez, a 1st year at Texas State University studying applied mathematics and minoring in data analysis. I love to listen to music as well as cooking and baking and going out with friends. I have plans to attend graduate school as I will be the first in my family to do so and later commission into the United States Air Force with dreams of being a pilot.

## Ethan Conner

*Undergraduate Student, Tarleton State University*

My name is Ethan Conner and I am a cybersecurity and mathematics student at Tarleton State University. I like math, security and programming.

## Jacqueline "Jackie" Medrano

*Undergraduate Student, Texas State University*

Hi! My name is Jacqueline Medrano, but you can call me Jackie. I'm from Austin, Texas—born and raised. As a first-generation student, I navigated everything related to college, from applications to scholarships, on my own. I'm currently double majoring in Mathematics and Computer Science. After earning my bachelor's, I'm uncertain whether to pursue industry work or go to graduate school. Outside of academics, I love traveling to new places, especially if it involves sightseeing in nature. When I'm not studying or traveling, you'll likely find me working out or hanging out with my friends and family.

Contact: *https://www.linkedin.com/in/jacquelinelmedrano/*

## Jano Scott

*Undergraduate Student, Tarleton State University*

A Computer Scientist that decided to take one too many Math classes and ended up here. I'm aspiring to go to graduate school afterwards and study advanced algorithms.

## Jared Richardson (M)

*PhD Student, University of Texas at Arlington*

My name is Jared Richardson, a second-semester PhD student at the University of Texas at Arlington. Most of my interest lies in statistics, probability, and computational methods, with a focus on applications to genetics and biostatistics. I personally love sweet treats and exploring nature. Additionally, I enjoy spending time with my family and playing with my two cats, Chunk and Orange.

Contact: *https://www.linkedin.com/in/jaredgrichardson/*





## Jason Bard

*PhD Student, University of Texas at Arlington*

Jason Bard is a second-year PhD student at The University of Texas at Arlington. His academic portfolio includes a Bachelor of Science in Pure Mathematics and minors in Data Science and Music, completed in May 2023. He is actively engaged in computational neuroscience research with Dr. Pedro D. Maia and has previously contributed to the UTA-USDA collaboration under the guidance of Dr. Jianzhong Su, Dr. William Beksi, and Dr. Phillip Owens. He enjoys watching baseball (go Rangers!) and playing video games.

Contact: *https://www.linkedin.com/in/jason-bard*

## Jonathan Enright

*Undergraduate Student, East Texas A&M University*

I am currently a Junior mathematics major at Texas A&M University Commerce, and I am currently doing some research in complex analysis for my thesis project. Outside of mathematics I really enjoy solving Rubik's cubes, and climbing. I also work at the climbing wall we have on campus.





## Jose Cortes

*PhD Student, University of Texas at Arlington*

I am a second year PhD student in the UTA mathematics department studying probability theory. I have my B.S. in Data Science and Mathematics from UT Arlington. I've been a researcher for 5 years and enjoy my doctorate work with the USDA Agricultural Research Service. On my off time I enjoy playing cello and being the treasurer of my colleges' chapter of the American Math Society.

Contact: *https://www.linkedin.com/in/cortesjoseandres/*

## Joseph Balderas

*PhD Student, University of Texas at Arlington*

I am a 4th year PhD student in the Mathematics Department at UTA. My research interests include reinforcement learning, dimensionality reduction, and data visualization. In my spare time, I enjoy playing piano, running, and watching movies!



## Kamiah Long

*Undergraduate Student, East Texas A&M University*



Hi, my name is Kamiah Long. You may not know me, but you will soon enough. I am a returning student and junior at East Texas A&M University. I originally studied math and computer science but recently switched my major to computer information systems and math. After high school, I attended Texas Christian University on scholarship, transferred to A&M Commerce, worked for AT&T HQ for 2-3 years in Information Technology, and returned to Commerce to finish my studies. This is my first ever math conference as an undergrad student. I like to read, cook, shop, and play video games in my free time. After college, I plan to work in digital forensics, network engineering, game development, or education. Feel free to ask me anything and I'll do my best to answer!

## Katie Grebel (M)

*PhD Candidate, University of Texas at Arlington*



Katie received her BS in math from TCU in 2015 and MS in math from UTA in May of 2023. She is currently a 5th year PhD student and is studying commutative algebra under Dr. David A. Jorgensen. Katie plans to stay in academia and work in math outreach and communication upon completing her PhD studies. Her hobbies include rock climbing, reading, playing card games, and chilling with her dog, Fiona. It is a goal of hers to be interviewed by Philomena Cunk one day.

## Khitam Aqel

*PhD Candidate, University of Texas at Arlington*



Khitam Aqel earned her B.S. degree in Mathematics from Jordan University of Science and Technology, Jordan, and her MSc in Mathematics degree from The American University of Sharjah, UAE. She worked as a Teaching Assistant in the Department of Mathematics and Statistics at the American University of Sharjah from 2012 to 2015. In 2016, she became a math lecturer at Ajman University's Mathematics & Sciences Department until the summer of 2020. In Fall 2020, she began her Ph.D. in Mathematics at The University of Texas at Arlington. Her current areas of study include computational neuroscience and dynamical systems. In her free time, she enjoys riding horses, car racing, working on car mechanics, DIY projects, solo traveling, and reading.

Contact: *https://www.linkedin.com/in/khitam-aqel/*

## Kyla Moore

*Undergraduate Student, Tarleton State University*

Kyla Moore is a student researcher at Tarleton State University in Texas, currently pursuing a degree in Mathematics with a concentration in Data Analysis. In addition to her research work, she is an active member of the Math Club and the Presidential Honors Program, reflecting her commitment to academic excellence. With aspirations to pursue a Master's degree in Mathematics, Kyla is focused on applying mathematical concepts to address real-world challenges and is eager to make a meaningful impact in her field.

## Kyle Earp

*Undergraduate Student, Tarleton State University*

My name is Kyle Earp, I am a senior Math and Computer Science major at Tarleton State University. I am currently looking at graduate programs to get my Ph.D. I started working in research my sophomore year and have learned so much in that time.

## Leah Rogers

*Undergraduate Student, Tarleton State University*

My name is Leah Rogers and I am a math major at Tarleton State University. I am in my third year of undergrad and the president of the Math Club.

## Mason Bane

*Undergraduate Student, Tarleton State University*

Mason Bane is pursuing a B.S. in Computer Science with a concentration in Computer Engineering and a minor in Mathematics at Tarleton State University. With a passion for solving complex problems, he is planning to pursue an advanced degree in computer science. Mason enjoys exploring new ideas, constantly learning, and applying his knowledge in diverse areas both academically and creatively.

## Mishu Devadasan

*Masters Student, University of Texas at Arlington*



Passionate about data science and analytics, I possess extensive expertise in Python, R, SAS, SQL, and machine learning. Currently pursuing a Master of Science in Applied Statistics and Data Science at the University of Texas at Arlington, I bring hands-on experience in predictive modeling, data visualization, and statistical analysis. With a background in engineering and a proven track record in academia and industry, I am dedicated to driving innovative solutions and making a positive impact in the field of data science.

Contact: *https://www.linkedin.com/in/mishudevadasan/*

## Rodina Eladawy

*PhD Student, University of Texas at Arlington*




Hi everyone, I'm Rodina. I graduated from Zagazig University in Egypt with a bachelor's and master's degree in statistics and applied statistics. Currently, I am pursuing my Ph.D. in Statistics at the University of Texas at Arlington (UTA).

My work in data analysis is motivated by my love of statistics, and I take pleasure in examining datasets to find patterns.

My research interests lie in the application of statistical methods and machine learning within various fields of cognitive and neural science.

My supervisor, Dr. Maia Pedro, has my sincere gratitude for all of his help and advice. I would not have been able to complete this assignment without his guidance, and his mentoring has given me valuable research skills.

## Ryan Stedman

*Undergraduate Student, Austin Community College*

My name Ryan and I'm studying Computer Science at Austin Community College. I'm currently doing undergraduate research with CURM. (Center for Undergraduate Research in Mathematics) I enjoy programming and learning new math concepts. In my free time I enjoy listening to and making music!

Contact: *https://www.linkedin.com/in/ryan-stedman/*

## Shammas Ahmed

*Undergraduate Student, Rice University*




Hi! I am Shammas Ahmed, a sophomore at Rice University studying Operations Research! My interest in math began after playing Pakistani card games with my grandmother. I was never good at recognizing tells or realizing when she would lie, so I would resort to estimating what hand she had given the cards already played using basic combinatorics (spoiler: i never won). In my free time, I DJ on the Rice radio station (shoutout ktru <3), organize events for the Rice Pakistani Student Association, and love attending concerts! I also enjoy playing squash, trekking and mountaineering, going on late night walks with my friends, and spontaneously deciding to buzz my hair!

Contact: *https://www.linkedin.com/in/shammas-ahmed05/*

## Shelby Clingan

*Undergraduate Student, Tarleton State University*



My name is Shelby Clingan and I am a senior scheduled to graduate May 2025 with a double major in mathematics and chemistry from Tarleton State University. I have been in the Honors College and a member of the Presidential Honors Program at Tarleton since 2021. I have also had the opportunity to work on research with the chemistry department since 2022 and the math department since 2023. Outside of class, I am the Vice President of the Tarleton Chemical Society, Marketing Chair of the Tarleton Math Club, Member of the Tarleton Ambassadors, and Senior Residential Leader for the Tarleton Department of Residence Life.

## Shreshtha Chaturvedi

*PhD Student, University of Texas at Arlington*



Hi! I am a 4th year PhD Student working in Applied Mathematics. My work is currently centered around neuroscience, dynamical systems, and developing automated ways to analyze sleep parameters of a neuronal network. I enjoy reading poetry, playing tennis, basketball - in fact, all kinds of sports. I am also an instructor for Calculus 1 this semester!

## Sundas Hussain

*PhD Candidate, University of Texas at Arlington*



Sundas Hussain is a dedicated PhD student in the Mathematics Department at the University of Texas at Arlington, where she focuses on Research in Undergraduate Mathematics Education. Currently, she serves as a graduate research assistant for the PROSPECT S-STEM project, funded by the National Science Foundation. This initiative seeks to foster equitable partnerships between associate-granting and bachelor-granting institutions, empowering low-income STEM transfer students to succeed.

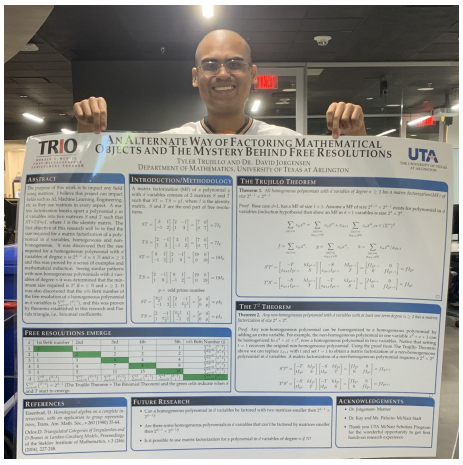
In addition to her research, Sundas is working on her dissertation, which investigates the problem-solving self-efficacy of mathematics majors at critical transition points in their undergraduate journey. Outside of her academic pursuits, she enjoys cooking and reading to her 3-year-old toddler, cherishing these moments of creativity and connection.

## Tatheer Ajani (M)

*PhD Candidate, University of Texas at Arlington*



Tatheer is a fifth year PhD student in Mathematics at UTA. She specializes in commutative algebra, and focuses in homological algebra. She graduated with her Bachelors in Mathematics in 2020 and with her Masters in Mathematics in 2023. She was greatly helped along her journey in STEM by her support system, which included friends, family, professors, and youth group leaders. Her interests include doing jigsaw puzzles, photography, bike riding, playing video games with her siblings, spending time at the mosque, and spending time with friends and family.



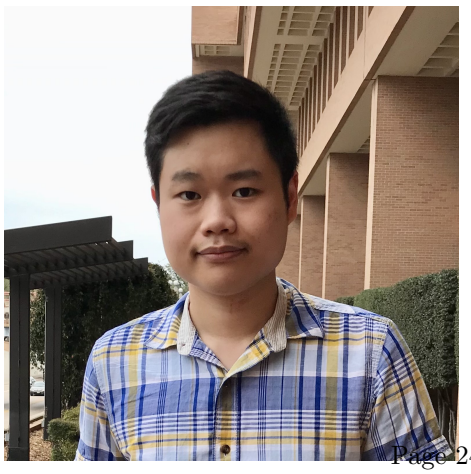

## Tyler "T$^2$" Trujillo

*Undergraduate Student, University of Texas at Arlington*

My name is Tyler Trujillo, I am a Junior Mathematics major aiming to be a math professor at a 4 year university in the future. The best thing I get to be on campus is being a math teacher in the Academic Success Center and Learning Resource Center as a math tutor. My favorite part about math is discovering new theorems and formulas that can have a positive impact on society in the future. My hobbies include doing math puzzles like Calcudoku (math version of Sudoku) and Sudoku. Outside of math I like to pass time by exercising going on long walks and doing the Stairmaster. I did my first research paper (titled an Alternate way of Factoring Mathematical Objects and the Mystery Behind Free Resolutions) with the McNair's Scholars Program here at UTA and I wrote 37 pages during summer of 2024.

## Will Chen (M)

*PhD Student, University of Texas at Arlington*



Will Chen started working toward a Ph.D. in Statistics and Data Science in August 2022 and received an Honors Bachelor of Science degree in Mathematics with minors in Biology and Computer Science in May 2022 at the University of Texas at Arlington. His research is primarily centered on the development and application of nonparametric statistical methods, particularly in the analysis of diverse public health data sets.

# Who's Who?

## Meet the Panelists

At Mathposium 2024, we are featuring three panels of mathematicians with unique backgrounds, stories, and experiences. On Saturday morning, we will feature the Business, Industry, and Government (BIG) Math Careers Panel. The BIG Math Network is an organization funded by major scientific communities, including the Society for Industrial and Applied Mathematics, American Mathematical Society, and the Mathematical Association of America. BIG Math brings together academic and industrial mathematicians to promote careers in business, industry, and government for students and provides students and universities across the nation with resources to help with the job hunt after finishing undergraduate or graduate studies in math. Our panelists on the BIG Math Careers Panel, have varied interests and experiences in mathematics. Drs. Ariel Leslie and John Montalbo both completed their doctoral studies at UT Arlington and went on to work for government and industrial organizations afterwards. Jorden Terrazas completed his undergraduate studies in Math and Stats at Southern Methodist University and has subsequently worked at AT&T in multiple roles as a Data Scientist while completing his Master's degree at Georgia Tech.

The second panel of the day will feature current UTA Math PhD students at various stages of their graduate education and the UTA Math Graduate Advisor, Dr. Hristo Kojouharov. The panelists will share their experiences applying to graduate school and life as a graduate students. Audience members will gain insight into the the day-to-day experience of graduate students, milestones each student must accomplish, and learn about challenges grad students face. For the first half of the session, the graduate advisor and math faculty will be present, but during the second half, the panel and audience will be reduced to just students for unfiltered access to the graduate student panelists!

Our third panel will focus on the hunt and experience at REUs and Internships as math students. REUs, or Research Experiences for Undergrads, are funded internships for students to spend a summer at another academic institution and work on a research project in STEM subjects. Math REUs, although competitive, are great experiences to broaden experiences in math as an undergrad, expand your network, and work on interesting projects in mathematics. Every year, the NSF and other funding agencies, fund 150-200 math REUs for students to participate in, and every REU differs from site to site. Two of our panelists, Amira Claxton and Dr. Talon Johnson, participated in REUs as undergraduate math students and will speak on their experiences looking for REUs and on what it's like to participate in one. Through REUs, students learn about conducting research in various fields of mathematics and usually also learn about creating a CV and choosing and applying to graduate schools. Internships in industry may be more appealing to those who do not plan on going to graduate school or academia. Many companies, government labs and agencies, and non-profit organizations hire math undergraduate and graduate student interns every summer and (sometimes) during academic semesters as well. These internships are generally more lucrative than REUs and provide different insights into careers mathematicians can jump into. The focus and structure of internships vary between hosting organizations, but securing an internship at a company/lab that is doing work you are interested in can be extremely beneficial for your career. While at UTA, Lasta Maharajan secured internships at The University of Texas System and worked as a research assistant at UTA among other roles. She is now an analyst at GM Financial, a subsidiary of General Motors. Together, Amira, Lasta, and Dr. Johnson will talk about their experiences looking for and participating in programs to enhance their undergraduate experience and will share advice and tips to help current students find REUs and internships.

# BIG Math Careers Panel

## Jorden Terrazas

*Senior Data Scientist, AT&T*



As a Sr. Data Scientist at AT&T, I build generative AI applications to support business operations across the company. I collaborate with other Data Scientists, Software Engineers, and DevOps professionals to create data pipelines, train, evaluate, deploy, and monitor ML models. I also communicate frequently with the internal clients to understand their needs and deliver solutions that meet their expectations and goals. I am currently pursuing a Masters of Computational Data Analytics at Georgia Institute of Technology, with a focus on Machine Learning. This program will help me develop my technical skills further and deepen my knowledge of the latest trends and best practices in the field. I have a strong background in Mathematics and Statistics, which I developed during my Bachelor of Science degree at Southern Methodist University. My analytical skills and problem-solving mindset have been essential for my work on machine learning problems at a national scale, and I hope to continue to leverage them in the future as I work on large-scale ML problems in a business setting.

Contact: *https://www.linkedin.com/in/jorden-terrazas/*



## Ariel Leslie, PhD (M)

*Data Analyst, Lockheed Martin Aeronautics*

Dr. Ariel Leslie is a native of the DFW metroplex. Upon graduation from Plano East Senior High, she attended Texas Southern University in Houston, TX where she obtained a BS in Mathematics and Health Studies. Dr. Leslie then received her doctoral degree of University of Texas at Arlington in Arlington, TX in December of 2019. She studied and published in the area of computational/mathematical neuroscience. While in graduate school, she was one of eleven National Science Foundation Louis Stokes Alliance for Minority Participation scholars. Dr. Leslie obtained awards for her research and teaching abilities. She is currently a Systems Engineer at Lockheed Martin Aeronautics, a defense company. Dr. Leslie enjoys spending time with her family and friends, volunteering, and teaching children all about STEM. Sharing crucial information about education and helping others is her true life passion.

Contact: *http://www.mathwithab.com/*

## John Montalbo, PhD (M)

*Applied Research Scientist, Trident Research*



My name is Dr. John Montalbo, and I am currently an Applied Research Scientist with Trident Research in Austin, Texas. I was born in San Antonio, Texas, but I have had the great pleasure of living throughout the United States during my childhood. I recently (2020) received my Ph.D. in Mathematics from the University of Texas at Arlington, as well as an MSc in mathematics from the University of Texas Rio Grande Valley and a BSc from the University of Texas Pan American. It was during my BSc in Edinburg, Texas, that I met my wife, Suzy. I have authored six scientific papers ranging in topics from mathematics education and standards to inverse problems and solutions, as well as received two graduate teaching awards during my doctorate for my commitment to undergraduate education. I have worked as a Data Scientist and Data Analyst as well since finishing my doctorate, but I enjoy my current role more as it allows me to directly utilize my mathematics background better. I work in underwater acoustics and help solve practical engineering problems with my team.

Contact: *https://www.linkedin.com/in/john-montalbo-phd/*

## Graduate School Panel

### Elizabeth Rubio (M)

*PhD Student, University of Texas at Arlington*



I am a second year PhD student at UTA beginning research in mathematical biology. My bachelor's degree is in Mathematics from Cal Poly Humboldt in northern California and I transferred there from Los Angeles Valley College (community college). For most of my undergraduate career, I did not even know what graduate school was! Master's, PhD and Postdoc were foreign words to me and so was "Research". Now that I am here, I see what an opportunity it is to pursue our curiosity in mathematics and so many other fields. One of the motivating factors for me is to increase accessibility of higher education for all students and diversify STEM by being myself and opening doors for others while I'm at it. I am excited to be doing interdisciplinary research in cancer biology and making an impact in this field.

Contact: *https://rubiomath.owlstown.net/*



### Dr. Hristo Kojouharov

*Mathematics Professor & Graduate Advisor, University of Texas at Arlington*

Dr. Hristo Kojouharov is a Professor of Mathematics and the Graduate Advisor for the Ph.D. and M.S. Programs in Mathematics at the University of Texas at Arlington. He earned his PhD in Mathematics from the University of Wyoming in 1998, and then spent two years as a Visiting Assistant Professor of Mathematics at Arizona State University. He was appointed to the faculty at UT Arlington in 2000. At present, Dr. Kojouharov is the Faculty Advisor for the student chapter of the Mathematical Association of America (MAA) at UTA and one of the faculty members in the NSF S-STEM SURGE program and in the DOE GAANN program at UTA. He is the director of the NSF funded Math for Human Health Research Training Group, was the director of the NSF funded UTTER (Undergraduate Training in Theoretical Ecology Research) program, and has also been heavily involved with the NSF GK-12 program at UTA. In addition, he is the director of the Annual UTA Calculus Bowl competition at the high-school level and was also of the Annual MAA Texas Section Calculus Bowl at the college/university level.

Contact: *https://hristo.utasites.cloud/, hristo@uta.edu*

### Tatheer Ajani (M)

*PhD Candidate, University of Texas at Arlington*



Tatheer is a fifth year PhD student in Mathematics at UTA. She specializes in commutative algebra, and focuses in homological algebra. She graduated with her Bachelors in Mathematics in 2020 and with her Masters in Mathematics in 2023. She was greatly helped along her journey in STEM by her support system, which included friends, family, professors, and youth group leaders. Her interests include doing jigsaw puzzles, photography, bike riding, playing video games with her siblings, spending time at the mosque, and spending time with friends and family.

## Joseph Balderas

*PhD Student, University of Texas at Arlington*

I am a 4th year PhD student in the Mathematics Department at UTA. My research interests include reinforcement learning, dimensionality reduction, and data visualization. In my spare time, I enjoy playing piano, running, and watching movies!



## REUs and Internships Panel

### Amira Claxton

*PhD Student, University of Texas at Arlington*



Hello! My name is Amira Claxton and I am a first-year PhD student in the Mathematics Department at UT Arlington. I am originally from the beautiful island of St. Croix in the United States Virgin Islands and earned my Bachelor of Science in Mathematics at the University of Tampa. My research interest is in mathematical biology and my academic journey has been characterized by my unwavering dedication to mathematics, my relentless pursuit of knowledge, and my deep-seated passion for contributing to the field. At UTA, I have been fortunate enough to become an NSF RTG Fellow, and it is my hope to become a professor of mathematics upon completion of my degree.

Contact: *https://www.linkedin.com/in/amira-claxton/*



### Talon Johnson, PhD (M)

*NSF MPS-Ascending Postdoctoral Research Fellow*

Dr. Talon Johnson earned his B.S. in Mathematics at Morehouse College in 2016 and Ph.D. in Mathematics from the University of Texas at Arlington (UTA) in 2021, specializing in mathematical imaging and compressive deconvolution with applications in medical imaging. As an NSF Mathematical and Physical Sciences Ascending Postdoctoral Fellow, he collaborates with the Advanced Imaging Research Center at the University of Texas Southwestern Medical Center (UTSW) and UTA's Department of Mathematics. His research focuses on the relationships between fat infiltration and muscle health, as well as on refining MRI data acquisition techniques. In addition to his research, Dr. Johnson actively mentors underrepresented students in STEM at UTA through the National Science and Technology Medals Foundation (NSTMF), providing guidance and support as they navigate their academic and career paths. He also supervises two students from Dallas College, guiding their research in computational neuroscience and epilepsy. Dr. Johnson's commitment to outreach and education is evident in his role as primary sponsor and co-organizer of Mathposium in 2022 and 2023. This year, he serves as Co-PI for the NSF-funded Mathposium, an initiative dedicated to engaging Texas students in mathematics. Dr. Johnson's contributions bridge innovative research with impactful mentorship and community engagement.

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### Lasta Maharajan

*Data Analyst, GM Financial*




I'm Lasta Maharjan, a mathematics and Data Science graduate currently working as a Data Analyst with General Motors Finance. As a Data Analyst I am passionate about turning complex data into clear, actionable insights. Previously, I have worked with the University of Texas System Administration, where I designed interactive dashboards and automate workflows that support data-driven decisions across departments.

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# Who's Who?

## Plenaries

This year's Mathposium will also feature two plenary talks from distinguished mathematicians who have made exceptional contributions in mathematics and academia. Dr. Minerva Cordero and Dr. Shelby Wilson bring expertise that spans educational leadership, data science, and cutting-edge research in mathematical biology and finite geometries.

Dr. Minerva Cordero is a Professor of Mathematics and Vice Provost for Faculty Success at the University of Texas at Arlington. Renowned for her work in finite geometries, Dr. Cordero has presented her research at national and international conferences and has received funding from the National Science Foundation and the National Security Agency. Her dedication to teaching has earned her numerous accolades, including the University of Texas System Regents' Outstanding Teaching Award. Passionate about increasing representation of women and underrepresented minorities in STEM, she received the prestigious Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring (PAESMEM) in 2022. Dr. Cordero's remarkable career includes service as an NSF Program Director, where she worked with initiatives supporting gender equity and Hispanic-serving institutions, and as an ambassador in the AAAS IF/THEN Ambassadors Program, encouraging young girls to pursue STEM careers.

Dr. Shelby Wilson is a Senior Data Scientist at the Johns Hopkins University Applied Physics Laboratory (JHU-APL) and serves as the Associate Applied Director for Education, Training, Outreach, and Participation at the NSF Center for the Analysis and Prediction of Pandemic Expansion (APPEX). As an applied mathematician specializing in mathematical biology, Dr. Wilson leverages parameter estimation, dynamical systems, network theory, and machine learning to model complex biological phenomena, such as cancer progression and epidemiological dynamics. Her work illustrates the versatility of mathematical tools in addressing pressing global issues, from public health to social dynamics.

Both speakers' talks will offer students and professionals alike a glimpse into the broad applications of mathematics across disciplines and inspire future paths in academia, research, and beyond.



## Dr. Minerva Cordero

*Vice Provost for Faculty Success, The University of Texas at Arlington*

Mathematician and 2016 Ford Legendary Woman Minerva Cordero is a Professor of Mathematics and Vice Provost for Faculty Success at the University of Texas at Arlington. During 2018-2019, she was a Program Director at the National Science Foundation (NSF), working with the Organizational Change for Gender Equity in STEM Academic Professions (ADVANCE) and the Hispanic Serving Institutions (HSI) programs. Subsequently, she served as an "expert" for the NSF Historically Black Colleges and Universities Undergraduate Program during 2022 and 2023.

She is a renowned researcher in the area of Finite Geometries and has presented her research at numerous national and international conferences. Her research has been funded by the National Science Foundation and the National Security Agency, among others.

Her teaching career spans over 25 years, and her passion and excellence in the classroom have been recognized by several prestigious teaching awards, including the Texas Mathematical Association of America Award for Distinguished College or University Teaching and the University of Texas System Regents' Outstanding Teaching Award.

She is passionate about increasing the number of women and other underrepresented minorities in mathematics and science. For her mentoring of underrepresented minorities in science, especially her work with Hispanic students, in 2016, she received the Great Minds in STEM HENAAC Award in Education. That same year, she was named a 2016 Ford Legendary Woman. In 2019, she was selected as an ambassador for the American Association for the Advancement of Science (AAAS) IF/THEN Ambassadors Program. The Lyda Hill Philanthropies sponsored the IF/THEN Ambassadors program. The IF/THEN Ambassadors program aims to recognize women's contributions in Science, Technology, Engineering, and Mathematics (STEM) and help encourage young girls to pursue careers in STEM. In 2022 Dr. Cordero was one of only 12 individuals nationwide selected by President Biden to receive the Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring (PAESMEM). More recently, she was named a Fellow of the Association for Women in Mathematics.

Cordero holds three degrees in mathematics: a doctorate (Ph.D.) from the University of Iowa, a Master of Arts from the University of California-Berkeley, and a Bachelor of Science degree from the University of Puerto Rico, her native land.



## Dr. Shelby Wilson

*Data Scientist, Johns Hopkins University Applied Physics Lab*

Dr. Shelby Wilson is an Applied Mathematician, a domain expert in Mathematical Biology, a fellow in the Association for Women in Mathematics (AWM), and a recognized community leader on diversity in mathematics. She is passionate about outreach efforts to facilitate an increase in diversity in math and has co-founded multiple service organizations, including Mathematically Gifted and Black, the Network for Minorities in Mathematical Science, and CodeHouse.

As the granddaughter of Etta Zuber Falconer, one of the first African American women to receive a PhD in Mathematics and a respected professor at Spelman College, Shelby grew up with a passion for mathematics, teaching, and increasing the number of minorities in mathematics and technical disciplines. Shelby pursued educational opportunities that would both help her grow as a technical professional and place her in supportive environments. She received a Bachelor of Science degree with two majors in Mathematics and Computer Science from Spelman College in 2006. Shelby participated in the Enhancing Diversity in Graduate Education (EDGE) program, which helps women and minorities prepare for graduate school in mathematics. There she built a strong network of fellow minority mathematicians who supported her through graduate school and later inspired her to help change the public face of mathematics.

Shelby went on to receive her Doctorate of Philosophy in Applied Mathematics from the University of Maryland College Park in 2012, studying mathematical biology and researching how dynamical systems modeling can inform cancer immunology. While in graduate school, Shelby began taking action to help increase diversity in mathematics professions, recognizing gaps in racial and gender diversity and more. Shelby became active in multiple professional societies including AWM and SIAM.

Since graduate school and for the past decade, Shelby has had an incredible academic career, including a postdoctoral research associate appointment at INRIA Grenoble in France, a tenured Associate Professorship of Mathematics at Morehouse College in Atlanta, and an Assistant Professorship of Biology at the University of Maryland College Park. She has authored more than 15 peer-reviewed journal articles, mentored hundreds of students, and developed practices to create professional opportunities for minorities that are benefitting many of her associates, students, and peers across her wide network. Her research interests lie in the use of techniques of parameter estimation, dynamical systems, network theory, and machine learning to create models of biological phenomena, e.g., cancer growth, sleep dynamics, and social organizations.

In 2017, Shelby and three colleagues partnered on an effort to promote diverse role models for students, and founded the Mathematically Gifted and Black website, which features a prominent black mathematician every day during black history month each February. As a result of their work, the site's accomplished mathematicians have been recognized broadly across many platforms, including the New York Times. Shelby and her team plan to sustain website operations through at least 2025.

During her time at Morehouse, Shelby worked with her students to found CodeHouse, a nonprofit organization that gives middle school students from Atlanta Public Schools exposure to technology by working directly with large technology companies like Google and Microsoft. She guided her students in hosting a large-scale event and in creating the nonprofit. Today, CodeHouse is addressing the diversity gap in technology by providing exposure and resources to enhance students' technical skills, promoting internships and full-time placement, and elevating the next generation of diverse leaders in technology. Shelby continues to provide coaching and guidance through her role on the Board of Directors.

In 2020, as the pandemic was starting, Shelby followed a calling to serve the nation and the world through pandemic response efforts. She became a senior mathematical researcher and technical leader at the Johns Hopkins Applied Physics Laboratory (APL). She has led multiple pandemic modeling teams, including a collaboration with the United Nations Office for Coordination of Humanitarian Affairs which published a COVID model designed for countries with ongoing humanitarian crises, as well as efforts with the Centers for Disease Control and Prevention. In parallel, Shelby has engaged in diversity recruiting efforts at APL and, through APL's Technology Leaders and Scholars program (ATLAS), has helped to foster positive internship experiences focused on technical and professional growth for students from minority serving institutions.

Dr. Shelby Wilson has had immense impact across both her technical work and community service efforts, driven by her passion to increase the number of minorities in STEM coupled with her passion for mathematics. In 2022, AWM honored Wilson as a fellow, noting "her unwavering dedication and work towards uplifting and inspiring women and Black mathematicians," and specifically calling out her role as a mentor and role model, as well her advocacy for a more inclusive mathematics community.

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$\sim$ Darsh, Talon, and the Mathposium team



*Land Acknowledgement:* UT Arlington respectfully acknowledges the Wichita and Affiliated Tribes upon whose historical homelands this university is located. We recognize the historical presence of the Caddo Nation and other Tribal Nations in the region.