Research Projects

**Faculty Mentored Research Projects**

* 2025

**The Geometry of Quantum Computing**

Jessie Wang, Angela Yu

Mentor: Geonhee Cho

* + Quantum computing can be studied through the lens of geometry, where the space of quantum states is naturally equipped with an information-geometric structure.

**ZX Algebra and Spider Fusion**

Jason Cheng, Evelyn Li

Mentor: Geonhee Cho

* + In quantum computing, qubits are described by complex values whose superposition and interference of its basis states, 0 or 1. Qubits, through normalization and the removal of the global phase, can be represented as points on the Bloch sphere, CP1, and traditionally, quantum operations represented by rotations of the Bloch sphere in which global phases are continuous, uniform, and fully unobservable.

**Prime Graphs of Finite Groups**

Bryan Alvarez, Micah Dorton, Lawrence Liu, Evan Zhang

Mentor: Thomas Keller

* + The subject of this project are prime graphs of finite groups with a focus on groups that are very close to solvable groups. There are several open questions on these graphs which are purely combinatorial in nature.

**Chip-Firing on Hypergraphs**

Jack Holden, Rafael Longoria, Keeran Patel, Jerry Zhang

Mentor: Anton Dochtermann

* + Our project seeks to create a strong definition for criticality on hypergraphs, and study the meaning of special configurations on hypergraph H. Further exploration could include considering chip-firing on hypergraphs by incorporating a stochastic model, giving the chips a randomly determined ”choice” of where to go when fired. Another question that arises is whether there exists some theory of ”activity”
	for spanning trees on hypergraphs.

**Attempting Simon's Conjecture for the 3D Case**

Benjamin Keller, Rhea Ghosal, Melody Han, Scarlett Kerr, Justin Liu, Ryan Tang, Chloe Weng

Mentor: Suho Oh

* + For proving, we are going to try various modifications of this conjecture for the 3-d case. For disproving it, we are going to test some recently developed machine learning techniques to try to search for potentially big counterexamples.

**Prime Factors and Dynamical Orbits**

Aristaa Bhardwaj, Adrian Boyer-Paulet, Emma Qiu, Alexander Sun

Mentor: Wade Hindes

Let S = {f\_1,…,f\_s} be a set of polynomials with integer coefficients, let M\_S denote the semigroup of all finite compositions of elements of S, and let b in **Z** be any basepoint. Then we are interested in studying the prime factors appearing in the orbit of b:

P\_S(b) := { primes p : p| f(b) for some f in M\_S }

In particular, we hope to prove that P\_S(b) is an infinite and "sparse" set of primes (i.e., Dirichlet density zero). Such a set of primes is useful for cryptography. To begin, we will consider sets of the form

S = {x^2+c\_1,…,x^2+c\_s}

for some c\_1,…,c\_s in **Z**.

**Development of a Fast Training Algorithm for Logistic Regression and Support Vector Machine**

Gloria Chi, Savanna Rocha, Kaylee Xu, Kelly Zhou

Mentor:  Young Ju Lee

* + Logistic regression and Support Vector machine are valuable tools for predicting the likelihood of an event. They help determine the probabilities between two or more classes. A very simple example is an email spam folder, for which, the Logistic regression can classify emails as spam or regular, and thus it can direct them to their respective inboxes.

**Accelerating Flash Calculations with the Orthogonal Greedy Algorithm**

Amanda Li, Nathan Negera, Cady Wang, Elena Xiao

Mentor:  Young Ju Lee

Solving large-scale optimization problems efficiently is a central task in many engineering
and scientific fields. In particular, flash calculations, which determine the phase compositions of multicomponent systems, are fundamental to computational thermodynamics and are widely used in chemical engineering simulations. These calculations often involve solving large systems of nonlinear or linear equations that require both speed and stability [1].

**Enviromental Impact of Hyperinflation**

**[Drawing the Connection Between Hyperinflation and Environmental Damage]**

Abigail Castaneda, Akash Gusani, Allysson Juarez, Thalia Kahozi, Anlan Xu, Emma Wu, Cody Zhou

Mentor:  Christopher Philip Guzelian,  Pratheesh Omana Sudhakaran, Michael Stutz

Cagan defines hyperinflation ”as a period of the economy beginning in the month the rise in prices exceeds 50 percent and as ending in the month before the monthly rise in prices drops below that amount and stays below for at least a year (Cagan). There have many occurrences of hyperinflation since World War I (e.g. Hungary in 1945, Zimbabwe
in 2007, and Yugoslavia in 1992) (Hanke Krus list). With consumer or wholesale price data for some or all of these geographies and time periods, we seek to determine using fractal Hurst exponents whether hyperinflation causes environmental damage (degraded aquifers, forests, fish, topsoil, livestock, wildlife, etc) with time lags in the same
locales/times.

**Enhancing Image Segmentation with Normalized Cuts and Inverse Filters**

Ryan Fitzgerald, Andy Lee, Kalia Wang, Jocelyn Wang

Mentor:  Ivan Ojeda-Ruiz

* + This project explores the application of inverse filters to enhance edge detection in image segmentation using the normalized cut algorithm. Image segmentation, a fundamental task in computer vision, involves partitioning an image into meaningful regions, and the normalized cut method is a powerful technique for achieving this by minimizing dissimilarities between segments while maximizing similarities within them.

**Creating a More Flexible Test for the Population Mean - Extensions to Bivariate and Longitudinal data**

Tomas Falleti-Moore, Emily Liu, Carolyn Wang

Mentor: Steve Hoberman

* + Statistics is the discipline where conclusions are reached in the presence of uncertainty using quantitative information. In this context, it is typical to assume the data are normally distributed. The most common test we use for the mean in this setting is the t-test. In this project, we study how a novel probability distribution can be useful in making inferences about the mean when the data may be either symmetric (like normal data) or skewed (different from normal).
* 2024

**Physically-Based Audio Effects**

Amanda Li, Rolando Martinez, Carolyn Wang, Jessie Wang

Mentor: Victor Cepeda

* + In this project, we aim to create a realistic simulated audio model by using digital signal processing to modify audio files to account for the pitch variations in echo/reverb that occur as a result of differences in the surrounding environment.

**Topology of the Turaev Genus of Knots**

Shreev Goyal, Joshua Kou, Emma Wu, Helen Yang, Aaron Zhou

Mentor: Christine Lee

* + Our project investigated the Turaev genus, a measure of how far a knot is from being alternating. Through applying the Jones polynomial and brute forcing through a family of knots with diagrams of Turaev genus 2, we identified five sub-families of knots with this property.

**Examining the Influence of Fairness Metrics on Clustering Algorithms**

Brandon Cardamone, Katherine Liu, Theo Sittig, Meiting Yang

Mentor: Ivan Ojeda-Ruiz

* + Clustering algorithms which partition data and generate partition centers come with biases that make them “unfair” when applied to different situations such as placing voting centers. In this project, we examine how applying fairness metrics to clustering algorithms affect how “fairly” the partitions and centers are generated.

**5-cycles in the Complements of Minimal Prime Graphs**

Micah Dorton, Ronok Ghosal, Ryan Tang, Justin Yu

Mentor: Thomas Keller

* + We studied MPGs, which connect graph theory and group theory. We tried proving that each edge in an MPG complement is always part of a 5-cycle. We did this by constructing a specific type of graph, and then inducting on it.

**Creating a More Flexible Test for the Population Mean**

Grace Huh, Albert Kim, Andy Zhou

Mentor: Steven Hoberman

* + We are attempting to improve the current t-test that we have in statistics. It works adequately for many data sets, but there are a subset of data sets for which it cannot accurately be run for, and we need an alternative for these data sets.

**Demazure Products of Type D Permutations**

Darren Han, Michelle Huang, Benjamin Keller, Jerry Zhang

Mentor: Suho Oh

* + Our project presents an efficient way to compute the Demazure product of type D permutations starting from their usual product and then applying a new operator called the hopping operator based on previous findings.

**Mitigating Bias Beyond Gender in Natural Language Processing**

Aien Du, Alicia Gu, Thalia Kahozi, Elizabeth Lei, Chloe Weng

Mentor: Ivan Ojeda-Ruiz

* + In the domain of Natural Language Processing (NLP) and machine learning, bias transcends traditional gender disparities to more complex distinctions such as race, religion, and socioeconomic status. Using corpus-level constraints and Lagrangian relaxation, we expanded the usage of Reducing Bias Amplification (RBA) to non-binary inputs of protected groups.

**Developing Fast Training Logistic Regression Models**

Nicolas Aldana, Anant Asthana, Gordon Chen, Tomas Faletti-Moore, Cameron Hong, Chloe Polin, Emma Qiu, Ram Sivaraman

Mentor: Young-Ju Lee

* + We propose to develop and assess fast solution techniques for logistic regression based on the Newton method and Heavy Balls method that was recently developed. The advantage of the Heavy Balls method is that it does not require Hessian computation, leading to a rather fast and efficient solver in CPU time.

**Comparing Performances of Neural Networks on Genetic Data**

Olivia Bley, Jason Cheng, Ethan Poon, Adriana Vigo, Angela Wang, Kalia Wang, Elena Xiao, Joseph Zhang

Mentor: Xiaoxi Shen

* + Our project compares the use of convolutional and recurrent neural networks to accurately predict traits based on genetic data. Through analyzing loss, we improved upon previous deep neural networks such as DanQ and DeepSEA to formulate better predictions.

**Derived Length of Solvable Groups**

Reiyah Jacobs, Cody Zhou

Mentor: Burcu Cinarci

* + We found the derived length of any group G in terms of the p-element centralizers of the group, denoted as k. We show that if G was solvable, the upper bound was k exactly, but if the group was nilpotent, the upper bound could be set as (k-1)/2 + 1.
* [2023](https://preview.gato.txst.edu/.preview/19/mathworks-archive-2/camps/summer-math-camps-information/hsmc/research-projects)

**2023 Research Projects**

**Analyzing Mathematical Teaching Methods Using Poisson Processes -***Adam Gonzales, Evelyn Li, Jason Li, Melissa Li, Avaneesh Parasnis, Maggie Yuan. Mentored by Alex White*

**Producing Socially Relevant Cuts Using Social Balance Theory As An Alternative To Spectral Clustering -***Brandon Peng, Joyce Qu, William Dai, Carolyn Lu, Michelle Huang, Benjamin Lu, Ethan Yang, Kevin Han. Mentored by Lucas Rusnak*

**Puzzles, Trianguloids, and Flips -***Shreev Goyal, Thalia Kahozi, Yunwoo Kim, Katherine Liu. Mentored by Suho Oh*

**A Study on Minimal and Superminimal Prime Graphs -***David Hovey, Joshua Kou, Ram Sivaraman, Emma Wu. Mentored by Thomas Keller*

**Irreducible Polynomials in Dynamical Systems -***Reiyah Jacobs, Benjamin Keller, Albert Kim, Aaron Zhou. Mentored by Wade Hindes*

**Tackling Biases in Machine Learning -***Zaina Ali, Adriana Cheng, Emma Dong, Jessie Wang, Meiting Yang, Allison Yao. Mentored by Ivan Ojeda-Ruiz*

**Estimation of Genetic Heritability -***Elizabeth Lei, Olivia Bley, Yury Guardado Iglesias, Andy Zhou. Mentored by Xiaoxi Shen*

**Incorporation Fairness Constraints into Spectral Clustering -***Jason Cheng, Elaine Wu, Joseph Zhang. Mentored by Young Ju Lee and Ivan Ojeda-Ruiz*

**Analysis of Artificial Intelligence Processes in Games Utilizing Fake Multiplayer -***Susan Hamiltom, Cameron Hong, Angela Yue. Mentored by Nathan Warshauer*

**Investigating the Use and Understanding of Spatial and Quantitative Coordinate Systems in STEM Fields -***Anjani Malhotra and Julia Trevino. Mentored by Hwa Young Lee*

* [2022](https://preview.gato.txst.edu/.preview/19/mathworks-archive-2/camps/summer-math-camps-information/hsmc/research-projects)

**2022 Research Projects**

* + **Data Encryption and Compression in Tandem -***Shreev Goyal, Amy He. Mentored by Dan Tamir*
	+ **The Function of Bezier Curve Graphing, Convex Hulling, and Slicing for an End-to-End 3D to 3DS Application -***Hanna Kenyatta, Brayden Mi, Ethan Yang. Mentored by Dan Tamir*
	+ **Combining Perception Considerations with Artificial Intelligence to Combat Bot User Interface -***Kevin Han, Evan Lai, Angela Yue. Mentored by Dan Tamir*
	+ **Comparative Analysis of Methods to Verify Distributed AI Systems -***Zaina Ali, Julia Ding, Aedin Pereira, William Wang. Mentored by Rodion Podorozhny*
	+ **Evaluation of Machine Learning Methods for Video-based Exercise Tracking -***Amy Chang, Jorik Dammann, Susan Hamilton, Angelina Richter. Mentored by Vangelis Metsis*
	+ **Generalizing Vizing's Theorem for Hypergraphs -***Georgia Bukata, Rebeca De La Garza, Alicia Lin, Alissa Shen, Klarissa Tey. Mentored by Tim Chase*
	+ **Irreducible Polynomials in Quadratic Semigroups -***Reiyah Jacobs, Peter ye. Mentored by Wade Hindes*
	+ **Investigating the Understanding of Spatial and Quantitative Coordinate Systems in Various Fields -***Anjani Malhorta, Katie Murphy, Julia Trevino. Mentored by Hwa Young Lee*
	+ **Identifying a Distance Metric that Maximizes Interrater Reliability -***Anant Asthana, Carolyn Lu, Jose Maria Salvador, Elaine Wu. Mentored by Alex White*
	+ **Proving a Homeomorphism between th Spaces of Boundary marked Points on the Unit Disk and Planar Rooted Metric Trees -***Alice Guo, August Warshauer, Christopher Qui. Mentored by Hiro Lee Tanaka*
	+ **Image Segmentation Using Constrained Normalized Cut Algorithm -***Samuel Salter, Kayley Sze. Mentored by Young Ju Lee*
	+ **Analyzing Methylation Patterns in Breast Cancer and Endometrial Cancer -***Juhi Pandit, Brandon Peng, Jackson Zane, Alice Zhong.**Mentored by Shuying Sun*
	+ **Bracket Form Parabolic Coset Structures of Bruhat Intervals -***Tina Li, Grace Yan, Kimberly You. Mentored by Suho Oh*
	+ **A Novel Spatiotemporal Epidemiological Networking Resilience Model for COVID-19 -***William Dai, Aaron Guo, Russell Li, Joyce Qu, Charles Sun, Sophia Zhong. Mentored by Lucas Rusnak*
* [2021](https://preview.gato.txst.edu/.preview/19/mathworks-archive-2/camps/summer-math-camps-information/hsmc/research-projects)

**2021 Research Projects**

* + **Stanley's Conjecture for Triconed Graphs -***Jacob David, Pierce Lai, Christopher Wu. Mentored by Suho Oh*
	+ **Studies on Spatio-Temporal Patterns of COVID-19 Pandemicin United States using DMD -***Amy Chang, Katie Murphy, Ayush Suresh, Richard Zheng. Mentored by Young Ju Lee*
	+ **How Novices Summarize and Explain the Key Ideas ofAnalysis Proofs -***Angela Landry, Mary Lee. Mentored by Kate Melhuish and Michael Hicks*
	+ **Using Process Mining Techniques on Classroom Data -***Sabrina Hu, Bibiane Kan, Hanna Kenyatta, Reiyah Jacobs, Juhi Pandit, Aaron Piando, Cynthia Zhang. Mentored by Kate Melhuish*
	+ **Minimal Prime Graphs of Solvable Groups: Properties, SizeBounds, and Generalizations -***Jael Dammann, Ethan Liu, Christopher Qiu, Devan Shah. Mentored by Thomas Keller*
	+ **Exploration of Topological Implications of Asymmetric 2 -Colorings of Graphs -***Rebeca De La Garza, Alicia Lin, Klarissa Tey. Mentored by Tim Chase*
	+ **An Exploration of the Jones Polynomial in Knot Theory -***Zaina Ali, Corona Chen, Sophie Cui, Jasmine Wang. Mentored by Tim Chase*
	+ **Generalizations of the Tutte Polynomial -***Alice Guo, Andy Jiang, Oliver Kahn, Rich Wang. Mentored by Lucas Rusnak*
	+ **Scientific Workflows -***Jonathan Liu, Samuel Salter. Mentored by Rodion Podorozhny*
	+ **Generalizing Kirchhoff Laws for Hypergraphs -***Amy Guan, Skyler Johnson, Jennifer Yan, Peter Ye. Mentored by Lucas Rusnak*
	+ **Improving Shannon-Fano-Elias Rate and Encryption Resilience -***Jeffrey Liu, Charles Sun. Mentored by Dan Tamir*
	+ **From 3D Point Cloud To Parametric Representation -***Nikola Cao, Sophia Zhong, William Wang. Mentored by Dan Tamir*
	+ **The Utility of Distributed Ledger Technologies in Management and Integrity Validation for Big Data Applications -***Alissa Shen, Samuel Tian, Ethan Yang, Dylan Yu. Mentored by Dan Tamir*
	+ **Chess Rating Prediction -***Evan Lai, August Warshauer.  Mentored by Alex White*
	+ **Analyzing Trends in Spotify Data Using Multivariable DataScience -***Christine Huang, Bibiane Kan, Hanna Kenyatta, Tina Li, Michelle Xiang. Mentored by Alex White*
	+ **What Online Behaviors Best Predict Academic Performance? -***Sabrina Hu, Reiyah Jacobs, Cynthia Zhang, Jennifer Zhang. Mentored by Alex White*
	+ **Effects of Diet on COVID-19 Deaths -***Michelle Chen, Flora Cheng, Aaron Guo, Alice Zhong. Mentored by Alex White*
* [2020](https://preview.gato.txst.edu/.preview/19/mathworks-archive-2/camps/summer-math-camps-information/hsmc/research-projects)

**2020 Research Projects**

* + **Tableau Stabilization**(Jacob D. David, Christopher Wu); Mentor:  Suho Oh
	+ **Comparative Analysis of Haploytpe Assembly Algorithms** (Daphne Han, Pierce W Lai, Sarah Wei); Mentor: Shuying Sun
	+ **BS Co-Methylation Patterns in Breast Cancer Samples**(Flora Cheng, Jael J Dammann, Christine Tian, Alice L Zhong); Mentor: Shuying Sun
	+ **Counting Prime Graphs of Finite Solvable Groups**(Ishita Goluguri, Eli P Meyers, Kenta J Suzuki); Mentor: Thomas Keller
	+ **Generalizing Kirchhoff Laws for Signed Graphs**(Amelia Yixin Hu, Skyler J Johnson, Peter Ye); Mentor: Lucas Rusnak
	+ **An Oriented Hypergraphic approach to Hadamard's Conjectures**(Russell A Li, Eric Yan, Justin Y Yu); Mentor: Lucas Rusnak
	+ **Simultaneous Compression and Encryption Using Improved Shannon-Fano-Elias Codes**(Amy K Chang, Rebeca De La Garza, Andrew C Jiang, Aman A Tewari); Mentor: Dan Tamir
	+ **Score-based Evaluation of Pseudo-Random Number Generators**(Ethan Liu, Jonathan C Liu, Isabella Quan); Mentor: Dan Tamir
	+ **Parametric Representation of Point Clouds Through Interpolation** (Susan Janet Hamilton, Alan Lin, Jason S Wu); Mentor: Dan Tamir
	+ **Computing with Words in Threat Detection Systems**(Alicia Y Lin, Raghav G Samavedam, Samuel Tian, Richard Z Zheng); Mentor: Dan Tamir
	+ **Student Definitions of Success at an Informal Math Camp**(Angela P Landry, William Wang); Mentor: Cody Patterson
	+ **Analysis of the Spread of COVID-19 and Impacts of Mitigation Interventions by using Cellular Phone Mobility Data in Jilin, China**(Alkiviades Boukas, Sophie T Cui, Esther M Lee, Mary M Lee); Mentor:  Alex White
	+ **A Multivariate Analysis of COVID-19 Disparities in 254 Rural vs Urban Counties in Texas using Multiple Linear Regression Models**(Amber K Luo, Charles Sean Sun, Jasmine Wang, Sophia Zhong); Mentor: Alex White
	+ **Poisson Process Analysis of Classroom Observation Data**(Jennifer J Zhang, Annie Z Zhu); Mentor: Alex White
	+ **Determining Explicit Forms and Relationships between Liouville Manifolds**(Alice Shanshan Guo, Naomi Kenyatta, Michelle Xiang); Mentor:  Hiro Lee Tanaka
	+ **Graph Balancing for Network Data Analysis**(Rachel A Laing, Allen Z Wu); Mentor:  Jelena Tesic
* [2019](https://preview.gato.txst.edu/.preview/19/mathworks-archive-2/camps/summer-math-camps-information/hsmc/research-projects)

**2019 HSMC Research Projects**

* + **Evaluation and Quantification of the Performance of Stream Ciphers -** *Dylan Dong, Ayush Suresh, Weilun Sun, Michelle Wang, Mentor: Dan Tamir*
	+ **B-Spline Surface Optimization for Sharp Feature Preservation -***Daniel Lee, Isabella Quan, Chris Wu, Jason Wu, Mentor: Dan Tamir*
	+ **Student Strategies When Attempting Combinatorial Games -***Kiara Chavez, Lino Guajardo, Emma Yu, Mentor: Cody Patterson*
	+ **Epidemic Intervention on Dynamic Metapopulation Networks -***Michael Li, Jack Qiao, Stephanie Wang, Jason Yuan, Mentor: Alex White*
	+ **Effects of Varying Subgroup Vaccination Rates on Risk of Herd Immunity Deterioration -***Daphne Han, Tara Roshan, Allison Yang, Hannah Zhang, Mentor: Alex White*
	+ **Dynamic Mode Decomposition for a Linear Operator with External Force -***Amy Guan, Esther Lee, Helen Wang, Annie Zhu, Mentor Young Ju Lee*
	+ **Lossless Data Compression on Unbounded Integers -***Patrick Peng, Samuel Tian, Alvin Xu, Mentor: Dan Tamir*
	+ **Graph Theoretic Algorithms for Social Network Analysis -***Sophie Cui, Rachel Laing, Angela Landry, Eileen Li, Mentors: Jelena Tesic and Lucas Rusnak*
	+ **Representable Matroids and Oriented Hypergraphs -***Selena Li, Brian Xu, Eric Yan, Shirley Zhu, Mentor: Lucas Rusnak*
	+ **Generalizing the Tutte Polynomial to Hypergraphs -***Michelle Li, Elijah Stroud, Michelle Xiang, Mentor: Lucas Rusnak*
	+ **Identifying Knot Structures in Known Protein Diagrams -***Andy Iyabor, Subi Kim, Radha Malhotra, Saba Zerefa, Mentor: Timothy Chase*
	+ **A Computational Assessment of the Probability of Knots in Protein Mechanisms -***Turner Bumbary, Andy Jiang, Sarah Wei, Sydney Zhou, Mentor: Timothy Chase*
	+ **Circuit-Chip Firing on Graphs -***Eli Meyers, Raghav Samavedam, Alex Yi, Mentor: Anton Dochtermann*
	+ **Prime Factors in Dynamical Orbits -***Kelly Cui, Jasmine Huang, Josh Kolenbrander, William Wang, Mentor: Wade Hindes*
* [2018](https://preview.gato.txst.edu/.preview/19/mathworks-archive-2/camps/summer-math-camps-information/hsmc/research-projects)

**2018 HSMC Research Projects**

* + **Algebraic Topological Methods for the Analysis and Modeling of Protein Data** - *Crystal Wang, Jason Yuan, Mentor: Dave Snyder*
	+ **Utility of Wormlike Micellar Fluids in Enhanced Oil Recovery-** *Pierce Lai, Michael Li, Sydney Zhou, Mentor: Young Ju Lee*
	+ **Correlation between the Tutte Polynomials of Simple Graphs, Bipartite Graphs, and Hypergraphs -***Devanshi Gupta, Danika Luo, Michelle Wang, Mentor: Lucas Rusnak*
	+ **A Complete Bound on the Chromatic Number and Index of Hypergraphs Through a Generalization of Vizing's Theorem -***Jenny Lu, Eric Wu, Amy Zhou, Mentor: Lucas Rusnak*
	+ **3D Mesh Generation through Triangle and Curve Algorithms -***Naomi Kenyatta, Raymond Suo, Allen Wu, Mentor: Dan Tamir*
	+ **Enhancement of the SLAM Algorithm between Two Autonomous Vehicles -***Richard Li, Michael Liu, Mahalet Mekonen, Mentor: Rodion Podorozhny*
	+ **Construction and Enumeration of Minimal Prime Graphs -***Josh Kolenbrander, Elijah Stroud, Selina Wu, Mentor: Thomas Keller*
	+ **An Integrative Evaluation of Statistical Tests for Pseudorandomness to Determine Optimum Randomness Criteria -***Asha Pereira, Helen Wang, Angela Zhang, Mentor: Dan Tamir*
	+ **Verification for the Correctness of Concurrent Data Structures -***Turner Bumbary, Amy Hu, Shilpita Mitra-Behura, Mentor: Rodion Podorozhny*
	+ **A Generalization of Polygonal Sperner's Lemma to Allow Duplicate Labels -***Sarah Wei, Alex Yi, Justin Yu, Mentor: Suho Oh*

**Siemens Competition Results**

Returning students in the Honors Summer Math Camp (HSMC) have the opportunity to conduct original math research projects in a team that can be submitted to various contests.  The HSMC has a strong record of producing award-winning research projects.  In 2009, a team from the HSMC won first place at the national level of the Siemens Competition, sharing a $100,000 college scholarship.

From 2001-2017, students' team entries have achieved the following in the Siemens Competition in Math, Science, and Technology:

* National Finalist: 5 teams
* Regional Finalist: 25 teams
* Semifinalist: 73 teams

This includes 192 students named as semifinalists, 72 regional finalists, and 14 national finalists.

[ExpandFAQ List](https://preview.gato.txst.edu/.preview/19/mathworks-archive-2/camps/summer-math-camps-information/hsmc/research-projects)

* [2017](https://preview.gato.txst.edu/.preview/19/mathworks-archive-2/camps/summer-math-camps-information/hsmc/research-projects)
	+ **Regional Finalist- "*Criteria for Determining Concordance in Positroids"***
		- ***Team: Andrew Lu, Claire Zhou, Brandon Chen***
		- **Mentor: Suho Oh**
	+ Semifinalist- "*Algebraic Topological Applications in Data Modeling and Analysis"*
		- *Team: Jenny Lu, Elijah Stroud, Rachel Laing*
		- *Mentor: David Snyder*
	+ Semifinalist: "*A Predictive Model of the Spontaneous Segregation of Spherical* *Nanoparticles Due to Force Imbalances"*
		- *Team: William Wang, Kyle Wang, Lucy Xu*
		- *Mentor: Gary Beall*
	+ Semifinalist- "*A Complete Characterization of Oriented Hypergraphs with Singular Laplacians"*
		- *Team: Junu Lee, Elizabeth Guo, Saba Zerefa*
		- *Lucas Rusnak*
	+ Semifinalist- "*A Numerical Study of Floating Drops"*
		- *Team: Eric Wu, Josh Kolenbrander, Grace Zhang*
		- *Mentor: Ray Treinen*
	+ Semifinalist- "*Integrated Analysis of Gene Expression and Methylation Data for Breast Cancer Cell Lines"*
		- *Team: Juyon Lee, Catherine Li, Jessica Ding*
		- *Mentor: Shuying Sun*
	+ Semifinalist- "*Topological Characterization of Graph Study"*
		- *Team: William Wang, Linda Yu, Kathleen Zhang*
		- *Mentor: Tim Chase*
	+ Semifinalist- "*A Novel Algorithm for Enhancing the naïve Bayes Spam Filter Through Text Modification Detection"*
		- *Team: Linda Huang, Julia Jia, Emma Ingram*
		- *Mentor: Wuxu Peng*
	+ Semifinalist- "*A Three Species Model for Wormlike Micellar Fluids in Porous Media and its Applications"*
		- *Team: Jonathan Shoemaker, Ethan Nolen*
		- *Mentor: Young Ju Lee*
* [2016](https://preview.gato.txst.edu/.preview/19/mathworks-archive-2/camps/summer-math-camps-information/hsmc/research-projects)
	+ Semifinalist - "[Applications of Grassmann Algebra on Laplacian Matrices and Their Properties"](https://www.google.com/search?q=Seimens+Semifinalist+2016+Grassmann+Algevra+on+Laplacian+Matrices+and+Their+Properties&ie=utf-8&oe=utf-8&client=firefox-b-1-ab)
		- Team: Junu Lee, Andrew Lu, and Sophia Sun
		- Mentor: Eugene Curtin
	+ Semifinalist - "A Generalization of Structural Degree of Imbalance and Complexity in Oriented Hypergraphs"
		- Team: Gina Chen, Vivian Liu, and Kyle Wang
		- Mentor: Lucas Rusnak
	+ Semifinalist - "DNA Co-Methylation Patterns in Cancerous and Normal Tissues"
		- Team: Emily Chen, Surya Namboodiri, and Lillian Sun
		- Mentor: Shuying Sun
	+ Semifinalist - "Exploring Energy Efficient Query Optimization Techniques for Databases Without Degrading Performance"
		- Team: Julia Jia, Catherine Li, and Angela Zhang
		- Mentor: Ziliang Zong
* [2015](https://preview.gato.txst.edu/.preview/19/mathworks-archive-2/camps/summer-math-camps-information/hsmc/research-projects)
	+ Regional Finalist - "Signed Path Matrices and Oriented Hypergraphic Generalizations"
		- Team: Eric Li, David Xiang, and Amber Lu
		- Mentor: Lucas Rusnak
	+ Semifinalist - "Clusters of Floating and Sessile Drops in the Absence of Gravity"
		- Team: Christine Jou and Yagmur Yuksel
		- Mentor: Ray Treinen
	+ Semifinalist - "A Combinatorial Proof for the Rank-Unimodality of Poset Order Ideals"
		- Team: Hans Li, William Liu, and Kevin Rao
		- Mentor: Edward Early
	+ Semifinalist - "Energy-Aware Deep Learning for Image Recognition"
		- Team: Lillian Bu, Michelle Hamilton, and Nina Osipova
		- Mentor: Ziliang Zong
* [2014](https://preview.gato.txst.edu/.preview/19/mathworks-archive-2/camps/summer-math-camps-information/hsmc/research-projects)
	+ Regional Finalist - "Identifying DNA Methylation Variation Patterns For Breast Cancer Biomarker Genes"
		- Team: Brandon Alston, Lily Xu, Simantini Mitra-Behura
		- Mentors: Shuying Sun and Ziliang Zong
	+ Semifinalist - "Improvements In 3D Volumetric Displays"
		- Team: Wilbur Li, YingYan Ho, Eric Gao
		- Mentor: Matt Gately
* [2013](https://preview.gato.txst.edu/.preview/19/mathworks-archive-2/camps/summer-math-camps-information/hsmc/research-projects)
	+ Regional Finalist - "Maximizing the Number Of K-Sets"
		- Team: Weiwei Chen, Patrick Guo, and Jessica Yu
		- Mentor: Edward Early
	+ Regional Finalist - "A Characterization of Balance in Oriented Hypernetworks via Generalized Signed Walks"
		- Team: Angie Rao, Alex Yang, and Vinci Chen
		- Mentor: Lucas Rusnak
	+ Semifinalist - "Generating Molecular Solubility Predictors Using Quantitative Structure Activity Relationships"
		- Team: Justin Zhang, Amber Guo, and Angela Feng
		- Mentor: Carl Fisher and Eumi Pyun
	+ Semifinalist - "A Game of Tri: A Graph Theoretic Generalization of Hex"
		- Team: Leslie Tu, Selcen Yuksel, and Michaela Taylor-Williams
		- Mentor: Eugene Curtin
	+ Semifinalist - "On the synthesis and predictive modeling of stable pigments utilizing silica extracted from rice husk biowastes"
		- Team: Caroline Gao, Susan Xu, and Lily Xu
		- Mentor: Luyi Sun
* [2012](https://preview.gato.txst.edu/.preview/19/mathworks-archive-2/camps/summer-math-camps-information/hsmc/research-projects)
	+ Regional Finalist - "A Novel Approach To Estimating Survival Functions For Interval Censored Data With STD Behavioral Diary Information"
		- Team: George Qi, Vinciane Chen, Robert Tung
		- Mentor: Qiang Zhao
	+ Semifinalist - "On The Ratios Of Binomial Coefficients"
		- Team: Leslie Tu, Catherine Yip, Aditya Jain
		- Mentor: Edward Early
* [2011](https://preview.gato.txst.edu/.preview/19/mathworks-archive-2/camps/summer-math-camps-information/hsmc/research-projects)
	+
	+ 5th Place National Finalist - "Determining the Existence of Graceful Valuations of Various Families of Graphs"
		- Team: Kevin Tian, Kevin Chang, Andrew Xu
		- Mentor: Edward Early
	+ Regional Finalist - "On the Acyclic Subgraphs of k-Majority Tournments"
		- Team: Alexandra Ilic, Bobby Shen, and Lilly Shen
		- Mentor: Jian Shen
	+ Semifinalist- "A Generalization of Sperner's Theorem for Multisets"
		- Team: Steven Chen, Amy Kang, and Jeremy Kalas
		- Mentor: Eugene Curtin
	+ Semifinalist- "Computing Spatio-Temporal Data with Applications to Hurricane Analysis"
		- Team: Ding Zhou and Jessica Wang
		- Mentor: Mark McKenney
	+ Semifinalist - "A Mathematical Model of Structural Behaviors and Physical Properties of Polymer Nanocomposites"
		- Team: George Qi, Catherine Liu, and Linda Zhang
		- Mentor: Gary Beall
* [2010](https://preview.gato.txst.edu/.preview/19/mathworks-archive-2/camps/summer-math-camps-information/hsmc/research-projects)
	+ Regional Finalist - " On the Power Dominating Set of Various Classes of Graphs"
		- Team: Alexandra Ilic, Ignacio Ramirez, and Kevin Tian
		- Mentor: Nathaniel Dean
	+ Regional Finalist - " Attainability of the chromatic numbers of functigraphs"

Team: George Qi and Daniel (Shenghao) Wang

Mentor: Weizhen Gu

* + Semifinalist - " An Application of Subsampling Quantile Estimators to Image Denoising"

Team:  Sophia (Wen) Chu and Sumit Gogia

Mentor: Alex White

* + Semifinalist - " On Relating the Prime-counting and Totient Functions to Pigeonhole Goldbach Partitions"

Team:  Patrick Kim and Michael Proulx

Mentor: Edward Early

* [2009](https://preview.gato.txst.edu/.preview/19/mathworks-archive-2/camps/summer-math-camps-information/hsmc/research-projects)
	+ National Finalists 1st Place  - "Relating Missing and Decycling Edges in Directed Graphs"

Team:  Dan Liu, Kevin Chen, Sean Karson

Mentor:  Jian Shen

* + Regional Finalist - "A Prediction of Nanocomposite Permeability from Monte Carlo Simulations and the Implications of the Constrained Polymer Region"

Team: Patrick Kim, Sumit Gogia, Vincent Yu

Mentor: Gary Beall

* + Semifinalist - "Creating and Deducing Structure using Domination Numbers in Permutation Graphs"

Team:  Max Wimberley, Millie Shi

Mentor: Weizhen Gu

* + Semifinalist - "The Rank Generating Function for Partially Ordered Rb(n)"

Team:  Fan-Hal Koung, Jennifer Hu, Rebecca Salinas

Mentor: Edward Early

* [2008](https://preview.gato.txst.edu/.preview/19/mathworks-archive-2/camps/summer-math-camps-information/hsmc/research-projects)
	+ 5th Place National Finalist - "Previously Unknown Parts of the Greene-Kleitman Partition for the Tamari Lattice"

Team:  Mark Zhang, R-J Lim

Mentor: Edward Early

* + Regional Finalist - "Survival Analysis of Gene Expression Data using Dimension Reduction Techniques"

Team:  Alicia Zhang, Jeffrey Chan, Sameer Deshpande

Mentor: Qiang Zhao

* + Semifinalist - "Analysis of Non-Static Two-Person Poker Models"

Team: Fan-Hal Koung, Jack Geller, Rick Bhattacharya

Mentor: Eugene Curtin

* + Semifinalist - “The Effect of Different Air Bubble Arrangements on the Dielectric Constant of Teflon”

Team:  Eunice Alade, Jennifer Hu, Scarrlett Yin

Mentor: Gary Beall

* + Semifinalist - “A Model to compute Settling Velocities of Non-Spherical Nanoparticles in a Centrifuge”

Team:  Aman Sharma, Manos Souganidis, Veronica Ray

Mentor: Gary Beall

* [2007](https://preview.gato.txst.edu/.preview/19/mathworks-archive-2/camps/summer-math-camps-information/hsmc/research-projects)
	+ Regional Finalist - “On Winning Strategies for General Two- and Three-Person Vertex Geography and the Characterization of Ck2 Games”

Team:  Jon Gonzales, Mark Zhang, Wesley Chen

Mentor: Nathaniel Dean

* + Regional Finalist - “Risk Neutral Exchange Options in Energy Markets”

Team:  Aman Sharma, Jean Shiao, Jeffrey Chan

Mentor: Thaleia Zariphopoulou and Eugene Curtin

* + Semifinalist - “General Properties of Partisan Subtraction Games”

Team:  Jeffrey Chen, R-J Lim, Stephanie Chan

Mentor: Nathaniel Dean

* + Semifinalist - “L(321) Labeling in Graphs"

Team:  Amy Proctor, Jasmine Thum, Kimberly Yeh

Mentor: Jian Shen

* + Semifinalist - “Modeling Gas Diffusion through Nanocomposites”

Team:  Bryan Wigianto, Faith Chan, Kevin Luecke

Mentor: Gary Beall

* [2006](https://preview.gato.txst.edu/.preview/19/mathworks-archive-2/camps/summer-math-camps-information/hsmc/research-projects)
	+ Regional Finalist - “On Free Minimal Edge Control Sets of Digraphs"

Team: Kimberly Yeh, Tiffany Tsang

Mentor: Xingde Jia

* + Regional Finalist - “Mathematical Developments of the Contact Network Model”

Team:  Stephanie Chan, Jacob Shapiro, David Price

Mentors: Alex White and Lauren Ancel-Meyers

* + Semifinalist - “Characterization of Maximal Antichains in Posets”

Team:  R-J Lim, Tal Einav, Wesley Chen

Mentor: Edward Early

* + Semifinalist - “Character Tables of the Symmetric Group"

Team:  Diana Lee, Jasmine Thum, Zijie Zhou

Mentor: Edward Early

* [2005](https://preview.gato.txst.edu/.preview/19/mathworks-archive-2/camps/summer-math-camps-information/hsmc/research-projects)
	+ Regional Finalist - “Error Correction in Searching and Sorting Algorithms”

Team:  Edward Schmerling, Jennifer Schmerling, Erik Feng

Mentor: Jian Shen

* + Regional Finalist - “Eccentricity Sequences of Graphs”

Team:  Alisha Seam, Stephanie Chan, Wesley Chen

Mentor: Daniela Ferrero

* + Semifinalist - “Extremal Cayley Graphs of Finite Cyclic Groups”

Team:  Elysia Sheu, Joseph Lee

Mentor: Xingde Jia

* [2004](https://preview.gato.txst.edu/.preview/19/mathworks-archive-2/camps/summer-math-camps-information/hsmc/research-projects)
	+ Regional Finalist - “The Power Domination Problem in Trees and other Bipartite Graphs”

Team:  Edward Schmerling, Jennifer Schmerling, Sarah Spikes

Mentor: Daniela Ferrero

* + Semifinalist - “Counting Maximal Triangle Free Graphs”

Team:  Elysia Sheu, Helen Zhang

Mentor: Susan Morey

* + Semifinalist - “Variations of the Four-Post Tower of Hanoi Puzzle”

Team:  Erica Rew, Erik Feng, Jonathan Einav

Mentor: Eugene Curtin

* + Semifinalist - “A Coloring on Graphs: The L(2,1) Labeling Problem”

Team:  Jeff Nanney, Joshua Lim, Kris Kazlowski

Mentor: Jian Shen

* [2003](https://preview.gato.txst.edu/.preview/19/mathworks-archive-2/camps/summer-math-camps-information/hsmc/research-projects)
	+ National Finalist 6th Place - "Eccentric Graphs of Block Graphs and Trees"

Team:  Araceli Fernandez, Hannah Chung, Yiduo Wang

Mentor: Weizhen Gu

* + Regional Finalist - "Various Cases of Seymour’s 2nd Neighborhood Conjecture for Directed Graphs"

Team:  Diya Banerjee, Helen Zhang, Jeff Nanney

Mentor: Jian Shen

* + Semifinalist - "Domination of Permutation Graphs"

Team:  Allyson Ho, Chong Jiang, Soham Banerjee

Mentor: Weizhen Gu

* [2002](https://preview.gato.txst.edu/.preview/19/mathworks-archive-2/camps/summer-math-camps-information/hsmc/research-projects)
	+ Regional Finalist - "Diameter of Path Graphs"

Team:  Alan Taylor, Hannah Chung, Jeremy Warshauer

Mentor: Daniela Ferrero

* + Semifinalist - "Dominant Planar Graphs"

Tam:  Araceli Fernandez, Diya Banerjee, Syed Ashrafulla

Mentor: Daniela Ferrero

* + Semifinalist - "Examining Four-Player Fair Division Algorithms"

Team:  Andrew Hsiau, Felicia Alderete, Will Boney

Mentors: Eugene Curtin and Cody Patterson

* [2001](https://preview.gato.txst.edu/.preview/19/mathworks-archive-2/camps/summer-math-camps-information/hsmc/research-projects)
	+ National Finalist 4th Place - "The Generalization of the De Bruijn Edge Sums"

Team:  Charles Hallford, Cynthia Chi, Rebecca Williams

Mentor: Daniela Ferrero

* + Semifinalist - "Game, Set, Match"

Team:  Alex Wright, Betty Yang, Yeeland Chen

Mentor: Eugene Curtin

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