Archived Colloquia for 2021-2022

Friday, April 29, 2022 - Dr. Khang Tran

By Zoom at 9 AM

Title: Zero distribution of a Sheffer sequence generated by an exponential generating function

Abstract:

In the past, Forgacs and I studied the zero distribution of various sequences of polynomials generated by finite recurrences or equivalently by rational generating functions. Recently, together with mathematicians from Sungkyunkwan University, we are making a transition to understand those generated by transcendental generating functions. This talk is about the second project in this direction. In particular we study the zeros of the sequence $\{P_m(s)\}_{m=0}^{\infty}$ generated by

$$\sum_{m=0}^{\infty} P_m(s)\frac{z^m}{m!} = e^{csz+\alpha z^2+\beta z^4}$$

where $c \neq 0$ and $\beta < 0$. We prove that the zeros of this sequence are either real or purely imaginary. This project is supported by RSCA 2021-2022.

Friday, March 18, 2022 - Dr. Sarah-Marie Belcastro (Director of MathILy and Research Affiliate at Smith College)

By Zoom at 1 PM

Title: Topological Graph Theory... and YOU!

Abstract: This presentation will introduce the field of topological graph theory. Along the way, YOU will get to work on some elementary problems and present your insights, so that YOU will acquire a sense of how mathematicians approach topological graph theory questions.

Short Bio: Sarah-Marie Belcastro is a free-range mathematician, currently Director of MathILy and Research Affiliate at Smith College. She earned her Ph.D. from the University of Michigan and did her undergraduate work at Haverford College. Sarah-Marie's primary research area is topological graph theory; she is also interested in the mathematics of knitting, dance, infectious disease modeling, and changing the world. She enjoys connecting people to each other, connecting ideas to each other, and connecting people to ideas. Sarah-Marie has written the introductory textbook Discrete Mathematics with Ducks and co-edited the volumes Making Mathematics with Needlework and Crafting by Concepts.

Presenter's personal website: http://www.toroidalsnark.net/

Friday, March 11 - Dr. Deb Agarwal (Senior Scientist, Data Science and Technology, Berkeley Lab)

By Zoom at 9 AM (Register in advance for the meeting at https://us06web.zoom.us/meeting/register/tZMtcOuorjIvHtSTHnx5gARCbgMrnTxW6-Ek)

Title: Enabling Science through Data Science at Berkeley Lab

Abstract: Understanding environmental systems, providing clean water, predicting water availability, and understanding material properties are just a few of the areas where data science is enabling science breakthroughs. This talk will describe some of these science challenges and the role for data science in helping to address these challenges. In a national laboratory environment, the focus is on team science and tackling challenges that require an integrated team of people from many disciplines. In this talk I will describe some of the challenges we as data scientists are helping to solve and some of the next data science and machine learning challenges that need to be tackled.

Short Bio: Dr. Agarwal is a Senior Scientist and the Data Science and Technology Department (http://dst.lbl.gov), Head at Lawrence Berkeley National Laboratory (LBNL). Dr. Agarwal's current research focuses on developing computational tools to enable scientists to more effectively organize and use their data to address challenges. Two of her current major projects include a data repository for Earth Science data and a water treatment innovation project called NAWI. She has worked on projects involving watershed understanding, tropical forests, soil carbon, carbon capture, cosmology, particle accelerators, and satellite data. Dr. Agarwal earned her BS in Mechanical Engineering from Purdue University. Her MS and PhD are from University of California, Santa Barbara in Computer Engineering.

Presenter Website: https://crd.lbl.gov/about/staff/data-science-and-technology/deborah-aagarwal/

Department Link: https://crd.lbl.gov/departments/data-science-and-technology/

Friday, February 25, 2022 - Sam Jones, Ph.D. (Center for Applied Scientific Computing (CASC) at Lawrence Livermore National Laboratory (LLNL))

By Zoom at 9 AM (Register in advance at https://us06web.zoom.us/meeting/register/tZUtd--prD4jHNG4w-kOFVoRqtOBFo-rrTPL)

Title: Large Scale Deep Learning Enabling Rapid COVID-19 Small Molecule Drug Design

Abstract: Despite remarkable progress in deep learning, substantial time is still required in training data and computationally intensive neural networks (e.g. 3.5 billion weakly labelled Instagram images trained on state-of-the art neural network for 22 days using 336 GPUs). Scientific applications of interest to the US national laboratories, Department of Energy (DOE) and National Institute of Health (NIH) are of equal or more challenging dimensions. Leveraging on High Performance Computing (HPC) resources available at the US national laboratories, how then can we train large-scale data and or models with either improved time to solution or the opportunity to achieve a higher quality solution via more extensive training? In this talk, I will present our on-going work in large-scale training of deep neural networks. In particular, I will discuss a multi-level tournament voting algorithm, Livermore Tournament Fast Batching (LTFB) for data parallel training, hyper parameter and neural architecture exploration, and uncertainty quantification of neural networks at scale. I will start off with a brief overview of parallel and distributed deep learning, discuss the LTFB abstractions and conclude with experimental studies from our recent work on reducing training time of a generative model on 1.613 billion drug compounds targeting COVID19, from days to minutes.

Short Bio: Dr. Sam Ade Jacobs is a computer scientist and a project lead in the Center for Applied Scientific Computing (CASC) at Lawrence Livermore National Laboratory (LLNL). He received his Ph.D. in Computer Science from Texas A&M University. Dr. Jacobs' broad research experiences and interests include parallel computing, large-scale graph (data) analytics, scalable machine learning, and robotics. Dr. Jacobs' current work focuses on developing new algorithms for large scale deep learning with applications in drug design, high energy physics, cosmology and global nuclear non-proliferation analysis. Dr. Jacobs' work represents significant advances to the broader field of computational sciences as well as to (big) data science by providing and maintaining unique data analytics capabilities. His approaches and tools are designed to operate on massive supercomputers at LLNL (and other DOE labs) and are tested on those machines. Department Link: https://computing.llnl.gov/casc/.

Friday, December 3, 2021 - Jennifer Elder

By Zoom at 9 AM

Title: Graphs of Sets of Reduced Words

Abstract: Any permutation in the finite symmetric group can be written as a product of simple transpositions of the form (i i+1). We use these transpositions to represent a permutation as a reduced word. In this talk, we will look at examples of permutations and the sets of reduced words we can generate. We will look at how these sets can produce an associated graph, and cover new results on breaking the graphs into subgraphs and counting the number of edges in each graph.

Short Bio: Jennifer Elder attended Fresno State for her Bachelor's and Master's degrees in Mathematics, graduating in 2014 and 2016 respectively. During her time as an undergraduate, she was a Fresno State Tensor Women Scholar, working in knot theory research with Elaina

Aceves under the supervision of Carmen Caprau. She also worked with Oscar Vega on expanding the research on GRIM, a combinatorial game on graphs, and was one of the original student organizers and activity leaders for Fresno State's Sonia Kovalevsky Mathematics Day. During the Master's program, Jennifer worked on "Generalizing the Futurama Theorem," which was research on products of permutations in the symmetric group. This project also gave her the best answer to the question that plagues theoretical mathematicians: "what are the applications of your research?" Defeating supervillains, thank you very much. She graduated with honors and earned the Mathematics Department Outstanding Thesis award. After leaving Fresno State, Jennifer went to Arizona State University for her Doctorate, which she finished in the Summer of 2021. Her dissertation was on permutations in the symmetric group in the field of algebraic combinatorics under the supervision of Susanna Fishel. During her time in Arizona, Jennifervolunteered yearly as an activity leader and guest panelist at ASU's Math Day and Sonia Kovalevsky Day. She worked on the leadership team for the ASU Association for Women in Mathematics Student Chapter, first in the position of Secretary and then as President.
Jennifer is now a Visiting Professor of Mathematics at Rockhurst University in Kansas City. She intends to stay in academia, continuing her research and working on curriculum and course structures to create a more equitable and inclusive environment for underrepresented students in STEM.

Friday, November 5, 2021 - Andrew Gillette, Ph.D. (Lawrence Livermore National Laboratory)

By Zoom at 11 AM

Title: Why are Mathematicians Jumping on the Machine Learning Bandwagon?

Abstract: "Scientific machine learning" is a catch-all term for many current and future directions of computational science research, especially at national laboratories. What can mathematicians bring to this very code-centric field? A lot, it turns out. Neural networks are now thought of not only as a tool for modeling physical phenomena, but also as classes of functions, similar to solution spaces for partial differential equations. Mathematicians are well-poised to leverage results from numerical analysis and computational geometry to aid in the rigorous design of neural networks for scientific studies. In this seminar, I will speak in detail about my research using Delaunay triangulations (a technique dating to the 1930s) to analyze sampling and training procedures for neural networks. Simple examples in 2D will motivate the approach, followed by extension to dimensions beyond the reach of classical computational geometry methods. I will present applications of these tools in the context of multiple lab-supported research programs.

Friday, October 29, 2021 - Elaina Aceves (University of Iowa)

By Zoom at 9 AM

Title: *Introduction to Train Tracks*

Abstract: In this talk, I will focus on 3-braids which are isomorphic to the mapping class group of a 3-punctured disk. Using this interpretation, I will introduce train tracks which can be used to measure the twisting of the braid, maximal splitting sequences, and Agol cycles. In the latter half of the talk, I will discuss my current research which is about detecting the conjugacy class of pseudo-Anosov 3-braids admitting a non-degenerate flype by using Agol cycles.

Short Bio: Elaina Aceves is originally from Tulare CA and had the great opportunity to attend Fresno State under the Smittcamp Family Honors College Scholarship. While at Fresno State, she was introduced to undergraduate mathematics research by Tamás Forgács and decided to change her major from engineering to mathematics. During the summer of 2012, Elaina participated in an REU in geometry with Ashley Klahr and David Heywood under the advisement of Oscar Vega. As a Fresno State Tensor Women Scholar, she also worked in knot theory research with Jennifer Elder under the advisement of Carmen Caprau. Elaina's undergraduate research would lead to two published papers, one in the Journal of Geometry and one in the Rose-Hulman Undergraduate Mathematics Journal. After obtaining her bachelor's degree in mathematics in 2014, Carmen would become her master's thesis advisor. Carmen supported Elaina to attend multiple mathematics conferences and become an activity leader in Sonia Kovalevsky Day. Elaina would graduate with her masters in 2016 and earn the Department of Mathematics' Outstanding Graduate Student award. Her master's thesis would lead to another published paper in the Journal of Knot Theory and its Ramifications. After graduating, Elaina went to the University of Iowa to earn her Mathematics PhD. During her first years at the University of Iowa, Elaina earned the Graduate Assistance in Areas of National Need Fellowship and became an Alfred P. Sloan scholar. She also earned the prestigious Ford Foundation Predoctoral Fellowship which supported her last three years of graduate study. While at Iowa, she has continued to promote females in mathematics by participating in Sonia Kovalevsky Day and outreach activities like Topology Kids Club. Elaina has also been a mentor and organizer in the student-run Directed Reading Program which seeks to involve undergraduates in the mathematical community and provide a place to study an interesting topic in mathematics. Under the advisement of Keiko Kawamuro, Elaina has continued her research in topology and plans to graduate with her PhD in May 2022. She hopes to attain an academic position where she can promote undergraduate research and continue to support underrepresented students in mathematics.

Friday, September 24, 2021 - Rick Archibald Ph.D. (Oak Ridge National Laboratory)

By Zoom at 9 AM

Title: *A Path to Applied Mathematics at the DOE*

Abstract: This presentation will highlight different applied mathematical research that is supported at the laboratory complex at the Department of Energy (DOE). It will focus on data

analytics and provide information on various programs designed to foster engagement with the DOE.

Short Bio: Dr. Archibald is group leader of Data Analysis and Machine Learning Group Oak Ridge National Laboratory and he is also the data analytics lead for the SciDAC DOE institute FASTMath. He received Ph.D. in Mathematics from Arizona State University in 2002, with Anne Gelb that is currently in the Department of Mathematics, at Dartmouth College. He works in the Computational and Applied Mathematics Group at Oak Ridge National Laboratory. His research interests lie in data reconstruction and analysis, high order edge detection, large scale optimization, time integration, and uncertainty quantification.

Presenter Website: https://www.ornl.gov/staff-profile/richard-k-archibald