ARPAN PAL

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RESEARCH INTEREST

As a PhD in Mathematics with a focus in Theoretical Computer Science and Complexity Theory, I have worked on the problems surrounding the exponent of matrix multiplication. My research explores the area of minimal border rank tensors, which play a crucial role in achieving the state-of-the-art bound for the exponent of matrix multiplication using Coppersmith-Winograd tensor. My research focuses on studying the geometric properties of these tensors and their applications in fields such as Phylogenetics and Algebraic Statistics. I have also worked on problems related to Algebraic Statistics and Convolution Neural Networks, and have a deep understanding of Algebraic Geometry, Representation Theory, Lie Algebras, Deep Learning, and Statistics.

EDUCATION

Texas A&M University Expected 2023
PhD in Mathematics
Dissertation: *Concise Tensors of Minimal Border Rank for Fast Matrix Multiplication*

Indian Statistical Institute Bangalore 2016 - 2017
Math PhD Coursework

Chennai Mathematical Institute 2014 - 2016
MSc in Mathematics
Thesis: *Exponential Bounds for Determinantal Complexity of the Permanent*

University of Burdwan 2010 - 2013
BSc(Hons) in Mathematics

TECHNICAL STRENGTHS

Languages and tools:	Python, SQL, R, MATLAB, SageMath, Octave, VOSviewer, GitHub, LaTeX
AI/ML:	Various ML algorithms, NLP, RNN, LSTM, BERT, Compuer Vision, CNN, Scikit-Learn, TensorFlow, Keras, PyTorch, Plotly-DASH
Operating Systems:	Mac, LINUX, Windows

TEACHING

Graduate Assistant Sept 2017 - Current
Texas A&M University *College Station, TX*

- Spring 2023: Grader for Linear Algebra
- Fall 2022: Teaching Assistant for Engineering Calculus II
- Spring 2022: Instructor for Finite Math (MATH 168)
- Spring 2021: Grader for Graduate Differential Geometry-I
- Spring 2020: Instructor for Business Calculus
- Fall 2019: Teaching Assistant for Engineering Calculus II
- Summer 2019: TA for Graduate Algebra Qual Prep
- Spring 2019: Teaching Assistant for Calculus II
- Fall 2018: Teaching Assistant for Engineering Calculus I

- Spring 2018: Grader for Complex Variables
- Fall 2017: Grader for Modern Algebra-I

Directed Reading Program Mentor Spring 2022
Texas A&M University *College Station, TX*

- Mentored a senior undergraduate student through a machine learning course followed by a project to build a model for stock price prediction

PUBLICATIONS AND PREPRINTS

1. **Concise Tensors of Minimal Border Rank**, with Joachim Jelisiejew and Joseph Landsberg
   - Math. Ann. (2023). https://doi.org/10.1007/s00208-023-02569-y
2. **Toric Structure in Stateged Tree Models through Symmetry Lie Algebra**, with Aida Maraj
   - *being written*

TALKS

2022

Oct **Geometry of Minimal Border Rank Tensors**, *Geometry Seminar*, Texas A&M University

Mar **Tensors of Minimal Border Rank**, *AMS Sectional Meeting*, Purdue University

2021

Nov **Tensors of Minimal Border Rank**, *SIAM Texas-Louisiana Annual Meeting*, South Padre Island

Sept **Tensors of Minimal Border Rank**, *GSO Seminar*, Texas A&M University

Aug **Concise Tensors of Minimal Border Rank**, *SIAM Conference on Aplied Algebraic Geometry (AG21)*

CONFERENCES AND BOOTCAMPS

2023

Apr Data Science Bootcamp, *Erdös Institute*

Mar Southwest Local Algebra Meeting (SLAM2022), *Baylor University*

2022

Nov Data Science Bootcamp, *Erdös Institute*

Oct Texas Algebraic Geometry Symposium (TAGS2022), *Texas A&M University*

Jul Math to Industry Bootcamp, *IMA at University of Minnesota*

May Algebraic Statistics 2022, *University of Hawai'i at Manoa*

May Data Science Bootcamp, *Erdös Institute*

Mar AMS Sectional Meeting, *Purdue University*

2021

Nov SIAM TX-LA Annual Meeting (TXLA21), *UT Rio Grande Valley*

Aug SIAM Conference on Applied Algebraic Geometry (AG21), *Virtual*

Jun Tensor Methods and Applications to Physical and Data Sciences, *IPAM at UCLA*

2020

Oct SIAM TX-LA Annual Meeting (TXLA20), *Virtual*

2019

Aug Summer School on Geometry and Modular Representation Theory of Algebraic Groups, *Stony Brook University*

Feb Southwest Local Algebra Meeting (SLAM2019), *UT El Paso*

Feb Texas Algebraic Geometry Symposium (TAGS2019), *UT Austin*

2018

Apr Texas Algebraic Geometry Symposium (TAGS2018), *Texas A&M University*

Feb Texas Geometry and Topology Conference (TGTC), *University of Houston*

PROJECTS

Automated Essay Evaluation using NLP, *Kaggle Competition* Nov 2022

- Participated in a natural language processing based kaggle competition for evaluating english essays on 6 different metrics
- Built a more than 40% accurate predictive model using BERT, Transformers and XGBoost
- Link

Modeling Prepayments in Mortgage Backed Securities, *U.S. Bank* Jul 2022

- Investigated and created an 87% accurate linear regression model of various macroeconomic factors such as, Home Price Appreciation (HPA), Housing Credit Availability Index (HCAI), Geographic Mobility, on the rate of mortgage prepayments (CPR) in a top-down approach
- As a bottom-up approach assessed and modeled effect of current interest rate on prepayment rate among borrowers from 3 different cohorts of credit-score

Cuisine Prediction from Ingredients, *Erdös Institute* May 2022

- Analyzed the text data of ingredients for recipes from 20 different cuisines
- Cleaned the data and trained multiple different classification algorithms using Word2Vec, Neural Network, XGBoost, Random Forest, and came up with an 80% accurate classification model for predicting cuisines from ingredients
- Link

Analyzing Publication Data from Texas A&M, *Data Science Competition, TAMIDS* April 2022

- Collected publication data, examined, performed time series analysis and visualized the collaboration among 6 different science departments at Texas A&M University using tools like VOSviewer, Matplotlib
- Won 4th prize at the competition along with the prize for best usage of outside data
- Link

Weather Station with Raspberry Pi, *Personal interest project* Feb 2022

- Designed and wrote the code in python for a weather station which takes the weather data through openweathermap api and displays the weather of two cities on a 7.8" epaper display attached to a raspberry pi
- Link

AWARDS AND SCHOLARSHIPS

2 Prizes at Data Science Competition, *Texas A&M Institute of Data Science*, 2022

PhD Research Fellowship, *Indian Statistical Institute, Bangalore* 2016

Institute Scholarship, *Chennai Mathematical Institute* 2015

NBHM MSc Fellowhsip, *Chennai Mathematical Institute* 2014

NBHM MSc Fellowship, *RKM Vivekananda University* 2013

OUTREACH AND SERVICE

Organized *Graduate Algebra Symposium*

- 2023 - at Texas A&M University
- 2022 - at UT Arlington

Volunteered at *Stat Math Fair, Texas A&M University*

- 2023
- 2022
- 2018

Volunteered at *Math Circle, Texas A&M University*

- 2023

Served for *Math Grad Diversity Committee, Texas A&M University*

- 2023 - President
- 2022 - President
- 2021 - Member
- 2020 - Member

Panelist at *Discussion with REU Students, MSRI, UC Berkeley*

- 2022