Lakshmi Ramesh

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Interested in Algebraic Geometry, Computer Algebra and Invariant Theory

Education

RPTU Kaiserslautern - *Master of Science*   2021 - 2024 (tentative)
Mathematics with specialisation in Algebra, Geometry and Computer Algebra

Indian Institute of Science Education and Research Mohali - *BS-MS Dual degree*   2015 - 2020
Major in Mathematics

Publications

Invariant Theory   *Book chapter (Springer)*
Wolfram Decker, Lakshmi Ramesh, Johannes Schmidt
Topics in invariant theory with examples in OSCAR - invariant rings of finite groups, **infinite linearly reductive groups** (my contribution) and Cox rings.

Projects

Computing Sheaf Cohomology Modules over Projective Space   2023 -
Masters Thesis project supervised by Dr. Janko Boehm, RPTU Kaiserslautern
Using the Berstein-Gel'fand-Gel'fand correspondence and the Tate resolution, one can compute the cohomology numbers of a coherent sheaf over project space. I am using the BGG correspondence to find an indirect method of constructing the sheaf cohomology modules that is more efficient than computing the Čech complex. To this end, I implemented Schreyer's parallelisable syzygy algorithm for modules over the exterior algebra in Singular, as well as modules over non-commutative rings and Betti tables in OSCAR.

Invariant Rings of Tori   2023 -
I am implementing the algorithm by Harm Derksen (using integer programming) to efficiently compute the fundamental invariants of tori in OSCAR. This project is undertaken with funding from the SFB-TRR 195 project, under the supervision of Prof. Max Horn and Prof. Wolfram Decker.

Invariant Rings of SLn   2023
I use Harm Derksen's algorithm to compute fundamental invariants of linearly reductive groups and Cayley's Omega process for SLn, and implemented invariant rings of reductive groups in OSCAR. This project is undertaken with funding from the SFB-TRR 195 project, under the supervision of Prof. Max Horn and Prof. Wolfram Decker.

Modules over Dedekind Domains   2022 - 2023
I developed the data structures and functionality of modules over Dedekind domains in Hecke (dependency of OSCAR), including modules with torsion, quotient modules, module homomorphisms and elemental functionality. This project is undertaken with funding from the SFB-TRR 195 project, under the supervision of Prof. Claus Fieker.

Affine Group Schemes   2019 - 2020
Masters Thesis project supervised by Dr. Varadharaj Srinivasan, IISER Mohali
This project followed texts by W.C.Waterhouse and Eiichi Abe, and focused on group schemes as representable ring functors and the duality between affine group schemes and Hopf Algebras. I also studied the impact of the ground field or ring on geometric properties like connectedness, and special finiteness properties in the case of matrix groups.

Random Walks and Urn Problems   2017
In this summer project with Dr. Sreekar Vadlamani at TIFR(CAM), Bangalore, I studied and simulated fundamental problems in probability theory, focusing on random walks and urn problems using MATLAB.

Work Experience

Research Assistant, RPTU Kaiserslautern
2022 – present

This position is funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) through the SBF-TRR 195 project for 'Symbolic Tools in Mathematics and their Application'. I study algorithms in computer algebra related to algebraic number theory and algebraic geometry, and implement them in 'Open Source Computer Algebra Research system', OSCAR.

Tutor
2021

In this teaching role at *Tution Wayanad Online*, I prepared course material in mathematics and physics. I taught lessons and handled tutorials for high school students from around India over video call (due to the pandemic). I gained skills in teaching and designing learning material.

Scholarships

INSPIRE Scholarship
2015 – 2020

Awarded by the Government of India

The INSPIRE scholarship, awarded to the top percentile of school graduates who pursue pure sciences, is a scheme by the Ministry of Science and Technology of the Government of India.

Workshops attended

Summer School – Quadratic Number Fields and Applications in Algebraic Geometry
2023

Hosted by RWTH Aachen. Included lecture series on Minimal Model Program, Fano Varieties and lightning talks in computational algebraic geometry.

Winter School – Computational Geometry
2022

Hosted by RPTU Kaiserslautern and ITWM Fraunhofer Institut. Included lecture series on elliptic fibrations, K3 surfaces and other topics by experts on the topics.

Extra curriculars

Leadership

Convener of Student Representative Council
2017 – 2018

Elected as the head of the official student representative council for the 2017-18 term, I attended to all academic and other affairs of the 1300 students in the residential campus of IISER Mohali.

Culture

Music: I have performed with the University Choir (classical) Kaiserslautern and the Choir of the Versöhnungskirche Kaiserslautern in 2023. I am a trained Carnatic classical musician, with an interest to infuse Carnatic music with western classical concepts.

Dance: Trained in Indian classical dance Bharatanatyam, I have performed in many cities in India for over a decade.

Visual Arts: I am a visual artist, specialising in portraits in pen and ink, and watercolour. I have participated in two group exhibitions in the Museum Pfalzgalerie Kaiserslautern, and two exhibitions in Vielfalter Cafe Kaiserslautern, apart from being featured in magazines and exhibitions in the past.

Skills

Julia, Singular, GPI Space, Latex
OSCAR - github.com/Lax202

Languages

English, Tamil, Hindi – Fluent
German – Proficient
Spanish, French – Conversational