1. Title and abstract

1.1. Speaker: Fred Diamond (King's College London)

The weight part of (generalizations of) Serre's Conjecture

Serre's Conjecture (now a theorem of Khare and Wintenberger) asserts that all odd, irreducible representations $\rho : \mathrm{Gal}(K/\mathbf{Q}) \to \mathrm{GL}_2(\mathbf{F}_{p^r})$ arise from modular forms. It also gives a recipe for the minimal weight (at least two) and level (prime to p) of such a form in terms of the local behavior of the Galois representation. I'll recall the statement of the conjecture, and a variant due to Edixhoven that accounts for modular forms of weight one. Then I'll discuss generalizations of the conjecture (including Edixhoven's variant) and survey what's known about them, with an emphasis on the recipe for the weight.

1.2. Speaker: Ken Ribet (UC Berkeley)

Title: Cyclotomic torsion points on Mazur's Jacobian $J_0(N)$, for N prime

Abstract: Well over forty years ago, I proved the finiteness of the group of cyclotomic torsion points of an abelian variety over a number field. There is a cluster of natural questions to ask about this group. I will explain what the group actually is in a specific case of interest and then segue into a short discussion of related open problems.

When I have spoken about this subject before, I have begun with a discussion of open problems and did not have time to talk much about the group in the title of this talk. As a variant, I'll start with the specific and then move to the general.

1.3. Speaker: B Ramakrishnan (Chennai Mathematical Institute)

Title: Figurate numbers, forms of mixed type and their representation numbers.

Abstract: In this talk, we consider the problem of determining formulas for the number of representations of a natural number by a linear combination of figurate numbers with positive integer coefficients. This is achieved by showing modularity of the corresponding generating function. We also consider the problem of finding formulas for the number of representations of a natural number by certain mixed forms. This is a joint work with Lalit Vaishya.

1.4. Speaker:

Ken Ono (University of Virginia)

Title: Partitions detect the prime numbers

Abstract: This talk presents infinitely many "partition theoretic" analogs of the classical work of Matiyasevich that resolved Hilbert's Tenth Problem in the negative. The Diophantine equations we consider involve equations of MacMahon's partition functions and their natural generalizations, and these equations have the property that their solutions are the prime numbers. The key observation is that the ring of quasimodular forms are generated additively by the relevant partition generating functions. This is joint work with Will Craig and Jan-Willem van Ittersum.

1.5.

Minimum number of disjoint pairs in a uniform family of subsets

Gyula O.H. Katona
Rényi Institute, Budapest
ohkatona@renyi.hu

Let $[n] = \{1, 2, \dots, n\}$ be our underlying set. $\binom{[n]}{k}$ will denote the family of all k-element subsets of $[n]$. A family $F \subset \binom{[n]}{k}$ is called intersecting if any pair of its members have a non-empty intersection. The celebrated theorem of Erdős, Ko and Rado states that if $2k \leq n$, $F \subset \binom{[n]}{k}$ is intersecting then $|F| \leq \binom{n-1}{k-1}$.

Therefore if F is larger, then there is a pair of disjoint members. But what is the minimum of the number $\mathrm{dp}(F)$ of the disjoint pairs if $|F|$ is given? This question was solved for the case $k = 2$ by Ahlswede and Katona. List the characteristic vectors (here two 1's and $n-2$ 0's) of the subsets in a lexicographic order. Then the minimum of $\mathrm{dp}(F)$ is obtained either for the first or for the last $|F|$ members. For arbitrary k the first result was found by G.O.H.Katona, G. Y. Katona nad Z. Katona : when $|F| = \binom{n-1}{k-1} + 1$ then $\mathrm{dp}(F) \geq \binom{n-k-1}{k-1}$ and the corresponding construction consists of the lexicographically first members. A major step in this direction was the result of Das, Gan

and Sudakov : when $|F| = \binom{n-1}{k-1} + r$ and n is large enough with respect to r then $\mathrm{dp}(F)$ is maximized for the lexicographically first members, again.

Let $\mathrm{DP}(F)$ denote the graph where the vertices are the members of F and two such vertices are adjacent if the corresponding sets are disjoint. If $|F| = \binom{n-1}{k-1} + 1$ then $\mathrm{dp}(F) = \binom{n-k-1}{k-1}$ achieved for a construction in which the edges of $\mathrm{DP}(F)$ form a star. In jointly written with Jasinska we proved that excluding this possibility, the "second best value" of $\mathrm{dp}(F)$ is $2\left(\binom{n-k-1}{k-1} - 1\right)$. The number of disjoint pairs is almost the double. In general we give a good lower bound on the number of disjoint pairs when $\tau(\mathrm{DP}(F))$, the minimum number of vertices covering all edges of $\tau(\mathrm{DP}(F))$ is given.

1.6. Speaker: Olivier Ramare (CNRS/ Institut de Mathématiques de Marseille)

Bilinear Decomposition through Sieve and sums of two squares —— ———— The Fourier polynomial $S(\alpha) = \sum_{n \le N} b(n)e(n\alpha)$ where $b(n)$ is the characteristic function of some set "of multiplicative sort" (say primes, or sums of two squares, ...) is a central object. It contains different informations than counting points results do. We will use the polynomial on sums of two squares and, more classically, the one on primes to examine the border between sieve and bilinear decompositions. Time depending, we will continue with more exploration of these Fourier polynomials.

1.7. Speaker: Vitezslav Kala (Charles University Prague)

Universal quadratic forms and the lifting problem

A quadratic form is universal if it represents all the positive integers. Over the ring of integers Z, the most well-known example is the sum of four squares, and all universal forms were characterized by the fascinating 290-Theorem of Bhargava and Hanke. In my talk, I'll start with an overview of universal quadratic forms over number fields. Then I'll mostly focus on the lifting problem for universal forms, i.e., on the question "when can a quadratic form with coefficients from a given number field be universal over a larger field?" (Based on joint works with Daejun Kim, Seok Hyeong Lee, and Pavlo Yatsyna.)

1.8. Speaker: Eknath Ghate (TIFR Mumbai)

Reductions of Galois representations using the Iwahori mod p LLC

Abstract:

We first recall the mod p Local Langlands Correspondence using Iwahori induction. We then use the Iwahori mod p LLC to compute the reductions of all 2-dimensional semi-stable representations of the Galois group of $\mathbb{Q}_p$ of weights up to $p+1$. We show that the reduction varies through an alternating sequence of irreducible and reducible representations.

In the reducible cases, we also determine the tricky constants appearing in the unramified characters completely. In principle, our method works for all weights. In particular, it lets us go beyond the earlier glass ceiling of weight $p-1$ which occurs in the deep work of Breuil-Mézard and Guerberoff-Park, allowing us to complete our proof of our zig-zag conjecture.

1.9. Speaker: Anupam Saikia (IIT Guwahati)
Title: Stability of Class Groups in $\mathbb{Z}_2$-Extensions
Speaker: Anupam Saikia, IIT Guwahati

Abstract: We discuss the growth of the 2-class group $A(K_n)$ of the n-th layer K_n in the cyclotomic $\mathbb{Z}_2$-extension of certain real quadratic fields $K = \mathbb{Q}(\sqrt{d})$. First we consider the case when 2 is ramified in K and d has three distinct prime factors. Next we consider the case when 2 is split in K. We show stability of $A(K_n)$, which implies vanishing of the Iwasawa λ-invariant as predicted by Greenberg's conjecture. It is joint work with H. Laxmi, a research scholar at IIT Guwahati.

1.10. Speaker : U K Anandvardhanan (IIT Mumbai)

Title: An Introduction to the Relative Langlands Programme

Abstract: The plan of the talk is to give a gentle introduction to some aspects of the relative Langlands programme. The interest here is in understanding representations contributing to harmonic analysis on symmetric spaces (or more generally spherical varieties). For a symmetric space G/H, such representations of G are said to be H-distinguished. There are local ("p-adic") and global ("adelic") notions of distinction and questions of interest may be local or global or local-global. Analogous questions are often studied also over finite groups

of Lie type. In this talk, we touch upon some of these topics in a few specific contexts.

1.11. Speaker : Sukumar Adhikari (RKMVERI)

Title: Ramsey-type theorems: Some early results and some related open questions

Abstract: We start with some early Ramsey-type theorems, which include Ramsey's theorem, a result of Schur and the van der Waerden theorem. After a brief discussion on early generalizations of these theorems, we take up a conjecture of Gurevich and some recent results related to monochromatic solutions of diophantine equations.

1.12. Speaker: Apoorva Khare (IISC Bangalore)

Schur polynomials: from Cauchy and Frobenius to Loewner and beyond, and from smooth functions to symmetric function identities

Abstract: Cauchy's identity (1840s) expands the determinant of the matrix $f[\mathbf{u}\mathbf{v}^T]$, where $f(t) = 1/(1-t)$ is applied entrywise to the $n \times n$ rank-one matrix $(u_i v_j)$. This was generalized by Frobenius (1880s). In a different century and context, Loewner (1960s) showed the vanishing of the initial Taylor coefficients of $\det f[t \cdot \mathbf{u}\mathbf{u}^T]$, where f is a smooth function. This theme also appears recently in the 2010s in matrix analysis, for f a polynomial.

This talk aims to bring this algebra and analysis together, by expanding $\det f[t \cdot \mathbf{u}\mathbf{v}^T]$ for all power series f. Time permitting, we will go from determinants to immanants for any character of the symmetric group, for bosonic or fermionic variables u_i and v_j. (Partly based on joint works with Alexander Belton, Dominique Guillot and Mihai Putinar; with Siddhartha Sahi; and with Terence Tao.)

1.13. Speaker: Jean Marc Deshoulliers (University of Bordeaux)

Title. Every integer in $\{1, 2, \ldots, 10, 11\}$ occurs infinitely often as the right most non zero digit of $n!$ in base 12.

Abstract. We shall present the result stated in the title, which is a recent result obtained jointly with Pascal Jelinek and Lukas Spiegelhofer and announced in arXiv:2412.09124.

1.14. Speaker: Mahan Mj (TIFR Mumbai)

Title: Exceptional directions in hyperbolic FPP

Abstract: First passage percolation (FPP) gives a well-known model of random geometry on a fixed background infinite graph. When we specialize to Cayley graphs of Gromov-hyperbolic groups G, random trees T emerge naturally. The first part of the talk will dwell on setting up hyperbolic FPP and outlining its basic properties. This will have a probabilistic emphasis.

In the second part, we will specialize to the study of exceptional directions, i.e. distinct random geodesics in T that converge asymptotically to the same point in the boundary $\partial G$of G. This will have a geometric group theoretic emphasis (joint work with Riddhipratim Basu).

1.15. Speaker: Anish Ghosh (TIFR Mumbai)

Title: Random walks on homogeneous spaces and Diophantine approximation on fractals.

Abstract: I will discuss random walks on the space of lattices and describe connections to Diophantine approximation. I will then describe a joint work with Gaurav Aggarwal where we establish a new classification theorem for stationary measures, prove a theorem that relates the genericity with respect to random walks to Birkhoff genericity and finally apply these theorems to obtain new results in Diophantine approximation.

1.16. Speaker: Madhavan Mukund (Chennai Mathematical Institute)

Title: Correctness in a Connected World

Abstract:

The aim of formal verification is to mathematically prove that a computational system is correct. When computing was primarily concerned with complicated calculations, correctness meant that the program should produce a mathematically valid output for each input. However, computing systems now play much more versatile roles. With networks of servers talking to each other and interacting with a global user base, it is not even clear how to rigorously define correct and incorrect behaviours. In this talk, we will survey the evolution of formal verification and highlight some of the challenges in the area.

1.17. Speaker: Meena Mahajan (IMSc Chennai)

Title: The complexity of computation, of communication, and of proofs.

Abstract: The notion of algorithmic computation is centuries old, as is the quest for efficient computation. A precise mathematical formulation of what can be considered efficient lies at the heart of the field of computational complexity.

The rules of logical reasoning, the art of debate, the nature of proof – these too have been objects of study for centuries. The field of proof complexity seeks to understand how long a proof needs to be, if it adheres to the syntax and the rule set of a specific proof system.

When multiple agents are involved in computation, as is increasingly often the case, the exchange of information between agents merits closer attention. Communication complexity focuses exclusively on analysing the amount of commmunication required.

Three different themes - algorithmic computation, logical reasoning, and the sharing of information - all viewed from the lens of complexity. This talk will highlight some intriguing and sometimes unexpected interconnections between these areas.

2. Young Scholar's talk

2.1. Speaker: Mithun Das (ICTP)

Title: Effective equidistribution of Galois orbits for mildly regular test functions.

Abstract: We shall discuss the study on effective versions of the celebrated Bilu's equidistribution theorem for Galois orbits of sequences of points of small height in the N-dimensional algebraic torus, identifying the qualitative dependence of the convergence in terms of the regularity of the test functions considered. This is joint work with E. Carneiro.

2.2. Speaker: Lokenath Kundu (IISER Mohali)

Title: The Dehn Function of Palindromic Automorphism
group of Free group

Abstract:

The palindromic automorphism group A(Fn) of a free group of rank n is a subgroup of Aut(Fn). The Dehn function of the group Aut(Fn) and Out(Fn) is exponential for n 3 and is known from the work of

Bridson and Vogtmann. In this talk, we present a joint work with Krishnendu Gongopadhyay in which, we determine the Dehn function of the palindromic automorphism group of Aut(Fn) for n 3. If time permits, we will also discuss the z classes of the reduced palindromic automorphisms.

2.3. Speaker: SRIJONEE SHABNAM CHAUDHURY (IISER Pune)
g-INVARIANTS OF SOME LOCAL AND GLOBAL RINGS

In this talk, we first introduce the basic notion of quadratic lattices and g-invariant over rings. After that, we try to discuss all the important progress in the study of finding the upper and lower bounds of g-invariants over the following rings: (a) The ring of rational integers, that is, Z. (b) Rings of integers of totally real and imaginary number fields. (c) Rings of integers of local number fields. Finally, we talk about the scope of further research on this topic and the application of lattice theory to coding theory and cryptography.

2.4. Speaker: Arvind Kumar (IIT Jammu)

Title: Certain squarefree levels of reducible modular mod ℓ Galois representations.

Abstract: Let $k \geq 2$ be an even integer, $\ell \geq \max\{5, k-1\}$ be a prime, and N be a squarefree positive integer. It is known that if the mod ℓ Galois representation $\overline{\rho}_f$ associated with a newform f of weight k, level N, and trivial nebentypus is reducible, then $\overline{\rho}_f \simeq 1 \oplus \overline{\chi}_\ell^{k-1}$, up to semisimplification, where $\bar{\chi}_\ell$ is the mod ℓ cyclotomic character. In this talk, we determine the necessary and sufficient conditions under which the mod ℓ representation $1 \oplus \overline{\chi}_\ell^{k-1}$ arises from a newform of weight k and prime level and also from level N with exactly two prime factors and specified Atkin-Lehner eigenvalues.

2.5. Speaker: Lalit Vaishya (ISI Delhi)

Title: Density result on certain sets associated to a Siegel modular form of degree 2.

Abstract: We prove explicit lower bounds for the natural density of the sets of primes p represented by a reduced form of negative discriminant D such that eigenvalues (p) of a Siegel cusp form of degree 2 satisfy c1 ¡ (p) ¡ c2 for the real numbers c1 and c2. A similar result

is also proved for the set of primes p represented by a reduced form of negative discriminant D such that —(p)— ¿ c. Analogous results are also valid if one replaces natural density by Dirichlet density. Moreover, we deal with various kinds of quantitative results concerning the comparison between the normalized Hecke eigenvalues over the prime p represented by a reduced form of negative discriminant D, of two distinct Siegel cuspidal Hecke eigenforms for the full symplectic group of degree 2 which are not Saito–Kurokawa lifts.

2.6. Speaker: Sayan Goswami (RKMVERI)

Monochromatic Translated Product and an Answer of Sahasrabudhe's Conjecture

Arithmetic Ramsey theory deals with the monochromatic patterns found in any given finite coloring of the natural numbers . Here "coloring" means disjoint partition and a set is called "monochromatic" if it is included in one piece of the partition. A collection of subsets of is called partition regular if, for every finite coloring of , there exists a monochromatic element $F \in$.

In this talk, we will discuss some recent developments around the sum product problems on Ramsey theory asking whether the pattern $\{x, y, xy, x + y\}$ is partition regular (see [**?**]). One of the recent breakthrough papers of J. Moreira [**?**] shows that $\{x, xy, x + y\}$ is partition regular. Though Moreira's argument is not enough to bring y in the same color, a recent study (see [**?**]) on his technique suggests that it is possible to get y in the same color with a mild variation. This shows that $\{x, y, xy, xy+y\}$ is partition regular, which disproves a conjecture of J. Sahasrabudhe (see [**?**, Question 31]) claiming that $\{x, y, (x+1)y\}$ is non-partition regular as well as this gives a near solution of the sum-product conjecture. We will discuss the proof.

2.7. Speaker: Arindam Jana (IISER Berhampur)

Mod p representations of GL2(Fq) using calculus