welcome to impa and to the first indo-brazilian symposium in mathematics

IMPA is one of the most renowned research institutions in Latin America and has exerted a profound impact in Brazilian Mathematics during the 56 years of its existence. The institute is nestled on the Tijuca Forest natural park and within walking distance of the Botanical Garden. We hope you will have the opportunity to enjoy the beauty of the city as well as the friendly academic atmosphere, so that the mathematical communities of India and Brazil come closer together to project and perform joint research activities.

Please find below some useful information that could help make your stay more enjoyable.

- **Computational Facilities:**

The participants can use the computers on the Hall of the 2nd floor or those in rooms 130 and 132.

• The login is guest01, guest02 or guest03
• The password is indobra2008

We also have wireless (WIFI) connection. The ESSID of the network is *impa-wl*
and the password is *impacastorina*.

❖ **Location of IMPA:**

IMPA is located near the Botanical Garden in the city of Rio de Janeiro, Brazil.
The address is:
Estrada Dona Castorina, 110 – CEP: 22460-320 Rio de Janeiro, RJ – Brasil.

However, many cab drivers may need the following instructions which we reproduce in Portuguese:

HORTO, Por Favor: Vou para o IMPA na Estrada Dona Castorina, 110.
NO FINAL da Rua PACHECO LEÃO à DIREITA DEPOIS do PONTO FINAL da LINHA DE ONIBUS 409.

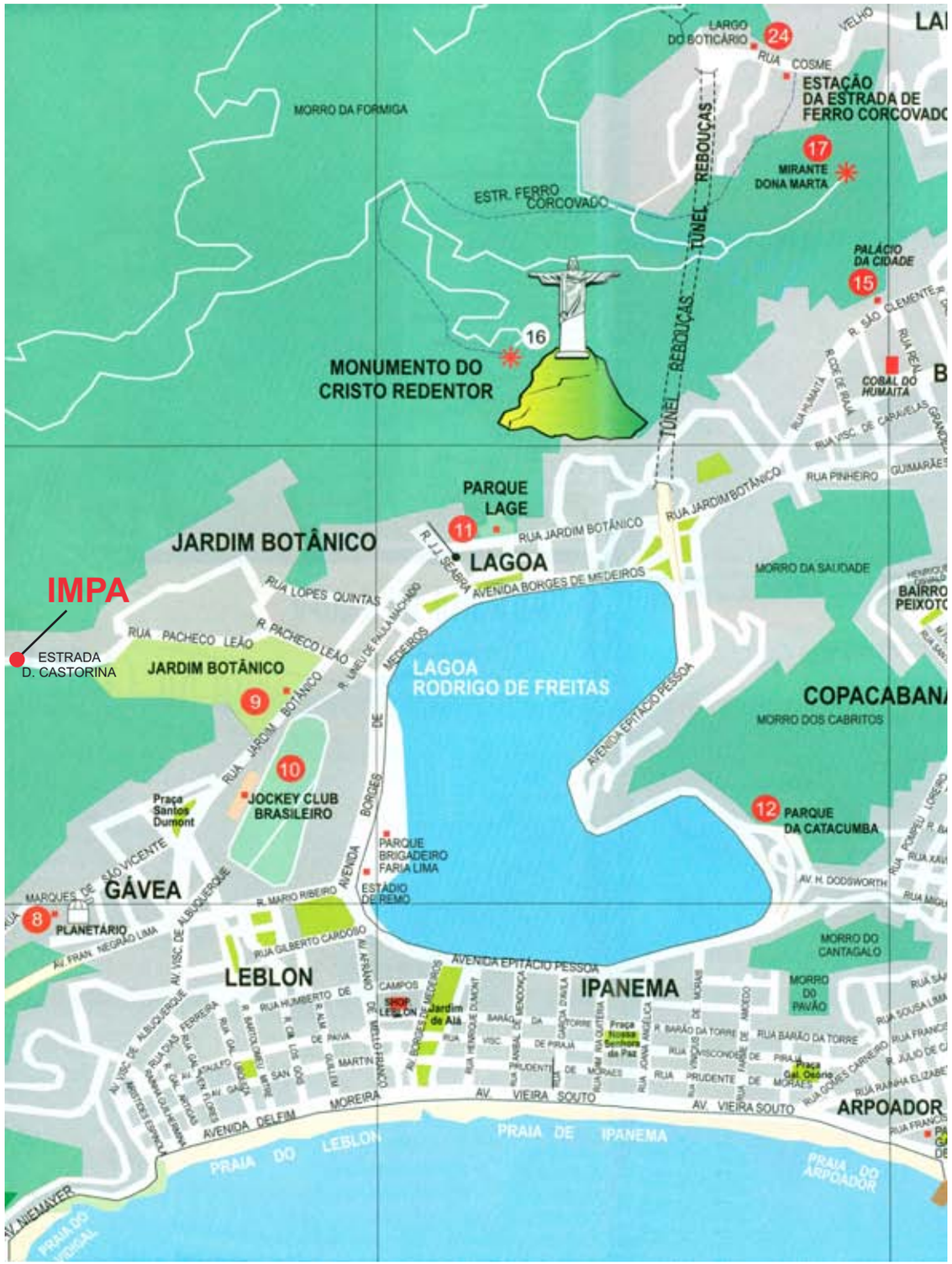
❖ **Public Transportation:**

How to get to IMPA:

The easiest and most cost effective (time wise) way to get to IMPA is by cab as described above. However, if you prefer to use public transportation see the next paragraph.

• **From Copacabana:**

You can use the bus line 125 (Jardim Botânico) from Avenida Princesa Isabel or Rua Barata Ribeiro and get off at the final stop. You should then walk uphill to Estrada Dona Castorina; IMPA is on the right hand side.



Since the 125 bus is somewhat infrequent, it is usually faster to follow a different route. Take the 572 or 584 bus and get off on Rua Jardim Botânico at the stop near ABBR and the “Pão de Açúcar” supermarket. Then, walk to Rua Lopes Quintas (which crosses Rua Jardim Botânico), go to the bus stop near the newsstand, take a 409 or 125 bus and get off at the final stop. From then on, follow the instructions at the end of the previous paragraph.

• **From Ipanema and Leblon**

You can use the bus line 125 (to Jardim Botânico) from Rua Prudente de Moraes (Ipanema), Avenida General San Martin (Leblon), or Avenida Bartolomeu Mitre (Leblon) and get off at the final stop. You should then walk uphill to Estrada Dona Castorina; IMPA is on the right hand side.
Since the 125 bus is somewhat infrequent, it is usually faster to follow a different route. Take the 572, 512 or 584 bus and get off on Rua Jardim Botânico at the stop near ABBR and the “Pão de Açúcar” supermarket. Then, walk to Rua Lopes Quintas (which crosses Rua Jardim Botânico), go to the bus stop near the newsstand, take a 409 or 125 bus and get off at the final stop. From then on, follow the instructions at the end of the previous paragraph.

• **From Flamengo, Botafogo and Humaitá**

You can use the bus line 409 (Sans Pena – Horto) from Praia do Flamengo (Flamengo Beach), Praia de Botafogo (Botafogo Beach) or Rua Humaitá, and get off at the final stop. Then walk uphill to Estrada Dona Castorina; IMPA is on the right hand side.

Program

Hour	Monday 28	Tuesday 29	Wednesday 30	Thursday 31	Friday 1
8:30AM - 9:00AM	Registration & Check in				
9:00AM - 9:35AM	A. Simis	E. Esteves	J. Hounie	C. Landim	Y. Kohayakawa
9:35AM -10:10AM	J. Verma	V. Balaji	A. Murthi	S. Athreya	P. Sen
10:10AM - 10:45AM	Coffee Break	Coffee Break	Coffee Break	Coffee Break	Coffee Break
10:45AM - 11:20AM	K. Pranjape	V. Sidoravicius	P. Srikanth	A. Bandyopadhyay	G. Misra
11:20AM - 11:55AM	M. Viana	V. Srinivas	H. Frid	M. E. Vares	R. Bhat
12:00PM - 02:00PM	LUNCH	LUNCH	LUNCH	LUNCH	LUNCH
02:00PM - 02:35PM	A. Hefez	D. Figueiredo	P. Ferrari	P. Cordaro	A. Lopes
02:35PM - 03:10PM	V. Suresh	M. Raghunathan	R. Roy	N. Garcia	G. Rangarajan
03:10PM - 03:45PM	C. Tomei	V. Sunder	V. Futorny	S. Ravi	N. Berkovits
03:45PM - 04:20PM	Coffee Break	Coffee Break	Coffee Break	Coffee Break	Coffee Break
04:20PM - 04:55PM	K. Sinha	A.Garcia	S. Dani	N. Shah	
04:55PM - 05:30PM	M. Soares	I. Vainsencher	A. Avila	M. Dajczer	
05:30PM - 06:00PM	Opening Ceremony	Free			
06:00PM - 08:00PM	**Cocktail**				

Absolute continuity, Lyapunov exponents and rigidity

Marcelo Viana, IMPA.

Abstract: I report on an ongoing joint project with Artur Avila and Amie Wilkinson, where ideas from the theory of linear cocycles are applied to the dynamics of partially hyperbolic diffeomorphisms.

The starting point is to view the diffeomorphism as a {\it smooth} cocycle over itself, acting on a fiber bundle whose fibers are the center leaves.

The sharpest results hold in dimension 3. We prove, in a number of situations, that absolute continuity of the foliation implies rigidity, meaning smooth conjugacy to a rigid model. Moreover, if absolute continuity breaks down then the disintegration must be atomic.

Random spatial growth with paralyzing obstacles

Maria Eulalia Vares

This talk will be based on a recent article in collaboration with J. van den Berg, Y. Peres and V. Sidoravicius (to appear in Ann. I Henri Poincare) We study a spatial growth processes where initially there are sources of growth (indicated by the colour green) and sources of a growth-stopping (paralyzing) substance (indicated by red). The green sources expand and may merge with others (there is no `inter-green' competition). The red substance remains passive as long as it is isolated. However, when a green cluster comes in touch with the red substance, it is immediately invaded by the latter, stops growing and starts to act as red substance itself. In our main model space is represented by a graph, of which initially each vertex is randomly green, red or white (vacant), and the growth of the green clusters is similar to that in first-passage percolation. The main issues we investigate are whether the model is well-defined on an infinite graph (e.g. the square lattice), and what can be said about the distribution of the size of a green cluster just before it is paralyzed. For the d-dimensional cubic lattice we show that, if the initial density of red vertices is positive, and that of white vertices is sufficiently small, the model is indeed well-defined and the above distribution has an exponential tail. In fact, we believe this to be true whenever the initial density of red is positive.

Mixed multiplicities of ideals and mixed volumes of polytopes

Jugal Verma

Abstract: The main results interpret mixed volumes of lattice polytopes as mixed multiplicities of ideals and mixed multiplicities of ideals as Samuel's multiplicities. In particular, we can give a purely algebraic proof of Bernstein's theorem which asserts that the number of common zeros of a system of Laurent polynomial equations in the torus is bounded above by the mixed volume of their Newton polytopes.

List of Abstracts

order by speaker

Jorge Hounie - Extensions of the Radó theorem

Y. Kohayakawa - A Problem in Probabilistic combinatorial number theory

Claudio Landim - Meta-stability and condensed zero-range processes on finite sets

Artur O. Lopes - Ergodic Optimization: Maximizing Probabilities, Subactions and L.D.P. for Gibbs Probabilities

Gadadhar Misra - Homogeneous operators

Adi Murthi - Hardy - Sobolev inequalities

Kapil H. Paranjape - Varieties defined over number fields

M. S. Raghunathan - On Thurston's conjecture on the first Betti number of hyperbolic 3-manifolds

Govindan Rangarajan - Time series analysis using non-parametric Granger causality

Rahul Roy - Coverage of space by random sets

Pranab Sen - Introduction to quantum computation

Nimish A. Shah - Limiting distributions of smooth curves under geodesic flow on hyperbolic manifolds

Vladas Sidoravicius - Stochastic structure of .critical. percolative and growth systems

Aron Simis - Bounds for the multiplicity of the special fiber

Kalyan B. Sinha - Non-Commutative Mathematics and Applications

Márcio G. Soares - Hypersurfaces invariant by one-dimensional projective foliantions

Ravi Sreenivasan - On limit distributions of maxima, random maxima, random sums

Planar Algebras and Hopf algebras

V.S. Sunder. *The Institute of Mathematical Sciences*. INDIA (talk at First Indo-Brazilian Symposium in Mathematics)

Abstract: After reviewing Vaughan Jones' notion of a planar algebra, we describe presentation - obtained in joint work with Vijay Kodiyalam and Zeph Landau - of th planar algebra associatedto a finite-dimensional Ka¸c algebra.

Isotropy of quadratic forms

Venapally Suresh, *University of Hyderabad*, Hyderabad India

Abstract: A homogeneous polynomial of degree two is called a quadratic form.
We say that a quadratic form is isotropic if it represents 0 non-trivially.
In this talk we study quadratic forms over the function field of p-adic curves.

Global geometry of some differential operators

Carlos Tomei, *Pontifícia Universidade Católica do Rio de Janeiro.*

Abstract: Many first and second order nonlinear ordinary differential equations are better understood when interpreted as the inversion of operators between function spaces.
The critical set of such operators is more structured than expected.

Revisiting Cerveau-Lins components

Israel Vainsencher, *ICEX-Departamento de Matemática-UFMG.*

Abstract: The irreducible components of the space of holomorphic foliations of degree two in CPn (n>2) were described in Ann.Math. 143 (1996). We consider the question of determining their degrees.

Complete intersection points on affine varieties and zero cycles

Vasudevan Srinivas

Tata Institute of Fundamental Research, Mumbai, India
web: www.math.tifr.res.in
email: srinivas@math.tifr.res.in

Let $X = \operatorname{Spec} A$ be an irreducible affine variety of dimension d over an algebraically closed field k, so that the coordinate ring A of algebraic functions on X is a finitely generated k-algebra which is an integral domain of Krull dimension d. A *complete intersection point* of X is a point $x \in X$ such that the maximal ideal $\mathfrak{M}_x \subset A$ of functions vanishing at x is generated by d elements $f_1, \ldots, f_d \in \mathfrak{M}_x$. Geometrically, this means that $x \in X$ is a non-singular point, and the hypersurfaces $H_i = \{y \in X | f_i(y) = 0\}$ satisfy $H_1 \cap \cdots \cap H_d = \{x\}$, and the H_i intersect transversally near x.

More generally, if $X = \operatorname{Spec} A$ is a reduced affine k-variety of dimension d, a point x is a complete intersection point if $\mathfrak{M}_x$ has height d, and is generated by d elements. Define a point $x \in X$ to be a non-singular point if its local ring $\mathcal{O}_{X,x}$ is a regular local ring of dimension d; clearly a complete intersection point is non-singular.

We are interested here in characterizing varieties $X = \operatorname{Spec} A$ such that all non-singular points $x \in X$ are complete intersections. This problem turns out to have different flavours, depending on the ground field k, and is related to interesting conjectures in the theory of algebraic cycles, and thereby to algebraic K-theory.

In this talk, I will give an introduction to this topic, dwelling in particular on some results based on the paper [3], and applications to complete intersections in [4].

Here are two results, proved in [4], using the results of [3]. Let $\overline{\mathbb{F}}_p$ denote the algbraic closure of a finite field of char. p, and let $\overline{\mathbb{Q}}$ denote the field of algebraic numbers (algebraic closure of $\mathbb{Q}$ in $\mathbb{C}$).

Theorem 1. *Let A be a finitely generated reduced $\overline{\mathbb{F}}_p$-algebra of dimension $d \geq 2$. Then any non-singular point of $X = \operatorname{Spec} A$ is a complete intersection point.*

Theorem 2. *Let $A = \oplus_{n \geq 0} A_n$ be a reduced, finitely generated $\overline{\mathbb{Q}}$-algebra of dimension $d \geq 2$. Then any non-singular point of $X = \operatorname{Spec} A$ is a complete intersection point.*

This leads to the following interesting examples (of "Bloch-Beilinson type"). Let $A = \mathbb{C}[x, y, z]/(f(x, y, z))$ be the homogeneous coordinate ring of a nonsingular plane curve of degree $d \geq 4$, where f has coefficients in $\overline{\mathbb{Q}}$. A non-singular point $(a, b, c) \in X = \operatorname{Spec} A \subset \mathbb{A}^3_{\mathbb{C}}$ is a complete intersection if and only if the point $[a : b : c] \in \operatorname{Proj} A \subset \mathbb{P}^2_{\mathbb{C}}$ is a $\overline{\mathbb{Q}}$-rational point (i.e., (a, b, c) is proportional to a triple of algebraic numbers).

Some survey articles giving background, detailed references, and explaining further the connections with commutative algebra, are [2] and [1].

On limit distributions of maxima, random maxima, random sums

Sreenivasan Ravi, *Univ. of Mysore*.

Abstract: Similar to the central limit theorem for sums of random variables, one can think of limit theorems for maxima of random variables. But, unlike in the central limit theorem, one can use nonlinear normalizations and obtain limit distributions for the maxima of iid random variables. This talk is about such limit distributions for maxima as well as random maxima. Some results on limit distributions for random sums are also discussed.

"Singularly perturbed elliptic equations with solutions concentrating on a 1-dimensional orbit"

P.N. Srikanth, *TIFR Centre for Applicable Mathematics*

Abstract: We consider a singularly perturebed elliptic equation with superlinear nonlinearity on an annulus in \mathbb{R}^{4} and look for solutions whcih are invariant under a fixed point free 1-parameter group action. We show that this probblem can be reduced to a non-homogeneous equation on a related annulus in dimension 3. The ground state solutions of this equation are single peaked solutions which concentrate near the inner boundary. Transforming back, these solutions produce a family of solutions whcih concentrate along the orbit of the group action near the inner boundary of the domain.

Stochastic structure of .critical. percolative and growth systems

Vladas Sidoravicius, *Instituto Nacional de Matemática Pura e Aplicada.*

Abstract: More than 50 years of studies of percolative and growth systems led to a very reach body of knowledge, and introduction of deep mathematical concepts in fields ranging from Probability and Ergodic Theory, Dynamical Systems, to Complex and Harmonic Analysis.

Bounds for the multiplicity of the special fiber

Aron Simis, *Universidade Federal de Pernambuco.*

Abstract: Given a standard graded ring A over a field k and a finitely graded A-module E generated in fixed degree and having a generic rank, we look for methods to bound the multiplicity of the special fiber of the Rees algebra of E, which is a standard k-algebra again. There are potential applications for the degrees of well-known algebraic varieties.

Semigroups of Maps on Operator Algebras and their Dilations

Kalyan Sinha, *J.N.Centre for Advanced Scientific Research and Indian Institute of Science, Bangalore.*

Abstract: Using the structure of a semigroup of normal completely positive maps on a *algebra in the case when the semigroup is uniformly continouous , it's stochastic dilation is constructed as a *-homomorphic flow on the algebra such that its expectation is precisely the semigroup one started with. In the general case of only strong continuity of the semigroup on a von Neumann algebra which is equipped with an action of a Lie group and a semifinite trace, a similar construction of a dilation is obtained.

Hypersurfaces invariant by one-dimensional projective foliations

Márcio G. Soares - UFMG

Abstract. We will survey old and new results on projective hypersurfaces which are invariant by holomorphic foliations of dimension 1 on $\mathbb{P}^n_{\mathbb{C}}$.

Conditioned Super-Brownian motion

Siva Athreya with Tom Salisbury**,** *Indian Statistical Institute*, Bangalore Centre.

Abstract: We extend earlier results on conditioning of super-Brownian motion to general branching rules. We obtain representations of the conditioned process, both as an h-transform, and as an unconditioned superprocess with immigration along a branching tree. Unlike the finite-variance branching setting, these trees are no longer binary, and strictly positive mass can be created at branch points. This construction is singular in the case of stable branching, and we analyze this singularity by approaching the stable branching function via analytic approximations. In this context the singularity of the stable case can be attributed to blowup of the mass created at the first branch of the tree.

Spectral gap for the SL(2,R) action in moduli space

Artur Avila**,** *Univ. Pierre et Marie Curie*

Abstract: We consider the Teichmuller flow in the unit cotangent bundle of the moduli space of (finite volume) Riemann surfaces. It is the diagonal flow of a natural SL(2,R) action which preserves the canonical volume form, of finite volume. We show that the Teichmuller flow is exponential mixing for a convenient class of observables, which implies that the SL(2,R) action has a spectral gap. This result is a particular case of a more general theorem (joint with Maria Joao Resende) showing the spectral gap for the restriction of the SL(2,R) action to arbitrary ``connected components of strata of quadratic differentials'', which extends earlier work (joint with Sebastien Gouezel and Jean-Christophe Yoccoz) about strata of squares.

Holonomy groups of stable bundles on projective varieties

Vikraman Balaji**,** *Chennai Mathematical Institute.*

Abstract: The Aim of the talk is to discuss some new devolpments in the study of stable bundles over smooth projective varieties of dimension greater than 1. We will discuss a generalization of the classical Narasimhan-Seshadri theorem for higher dimensional veriaties. This is based on joint papers with J.Kollar and A.J.Parameswaran.

Annealed and Quenched IP for Random Walk in Dynamic Markovian Environment

Antar Bandyopadhyay

Abstract

In this talk we will consider a model, introduced first by Boldrighini, Minlos and Pellegrinotti (1997, 2000) of discrete time random walks in dynamical random environments on the integer lattice $\mathbb{Z}^d$ with $d \geq 1$. In this model, the environment changes over time in a Markovian manner, independently across sites, while the walker uses the environment at its current location in order to make the next transition. Boldrighini, Minlos and Pellegrinotti (2000) used cluster expansions approach to establish quenched CLT when dimension $d \geq 3$. In an earlier work (2006) jointly with Ofer Zeitouni we gave a probabilistic argument based on regeneration times, and proved annealed SLLN and invariance principle (IP) for any dimension, and provide a quenched IP for dimension $d > 7$, which provided for $d > 7$ an alternative to the analytical approach of the earlier works, with the added benefit that it was valid under weaker assumptions. In this work we propose a different "regeneration time" which is more intuitive and can prove all the results (annealed SLLN, annealed and quenched IP) in any dimension $d \geq 1$ under the same weaker assumptions. In particular this provides new results for dimensions $d = 1$ and $d = 2$ when the environment chain is a non-trivial Markov chain.

In this talk we will discuss in detail the construction of this new "regeneration time" approach and indicate the proofs for the annealed and quenched IP.

[This is a joint work with Ofer Zeitouni.]

Superstring Theory and Pure Spinors

Nathan Berkovits, *Indian Statistical Institute, New Delhi.*

Abstract: Superstring theory has been useful for unifying quantum mechanics and general relativity into a consistent model. This theory requires supersymmetry, which is a symmetry relating bosons and fermions in the model. Recent progress in using pure spinors to understand the role of supersymmetry in superstring theory will be reviewed.

Introduction to quantum computation

Pranab Sen**,** *Tata Institute of Fundamental Research*

Abstract: Present computational models, hereafter referred to as classical computational models, use a bit as the basic unit of information storage. A bit is nothing but a device which can exist in exactly one of two distinct states, called 0 and 1, at any point of time. A bit can be modelled as a probability distribution over 0 and 1, and its time evolution can be described by a stochastic matrix. In quantum computation, the basic unit of information storage is a quantum bit or qubit. Measuring a qubit at any point of time gives exactly one of two distinct states 0 or 1, but otherwise, a bit can exist in so-called superpositional states which are modelled as unit Euclidean length tuples over complex numbers. Time evolution of a qubit is modelled by a unitary matrix. The availability of these extra superpositional states at intermediates stages of the computation gives rise to intriguing information theoretic and computational properties. For example, no efficient classical algorithms to factor integers are known, but there is an efficient quantum algorithm for the same by Peter Shor.

This talk will be an introduction to the basic model of quantum computation followed a by brief high level description of another gem of quantum computation, namely Grover's algorithm for searching a database. No prior knowledge of quantum computation is required.

Limiting distributions of smooth curves under geodesic flow on hyperbolic manifolds

Nimish A. Shah, *Tata Institute of Fundamental Research*, Mumbai

Abstract: We describe the asymptotic behaviour of the evolution of a segment of a smooth curve under the geodesic flow on the unit tangent bundle of a compact (or finite volume) hyperbolic n-manifold. We show that under a natural geometric condition on the curve, the pushforward of the normalized parameter measure on the curve under the geodesic flow gets asymptotically equidistributed in space.

Time series analysis using non-parametric Granger causality

Govindan Rangarajan, *Indian Institute of Science*

Experiments in many fields of science and engineering yield data in the form of time series. The Fourier and wavelet transform-based nonparametric methods are used widely to study the spectral characteristics of these time series data. Here, we extend the framework of nonparametric spectral methods to include the estimation of Granger causality spectra for assessing directional influences. We illustrate the utility of the proposed methods using synthetic data from network models consisting of interacting dynamical systems.

Coverage of space by random sets

Rahul Roy, *Indian Statistical Institute, New Delhi.*

Abstract: A cube of random size is placed at a point of a Poisson point process in the d-dimensional quadrant of a Euclidean space. We study the distribution required of the size of the cube vis-a-vis the density of the Poisson point process so as to ensure that an isomorphic copy of the quadrant is completely covered by the union of the cubes.
In the 1-dimensional case, this coverage study is equivalent to studying the busy period of a queue. A phase transition obtained in this 1-dimensional case may be employed for a statistical study of the number of servers required to manage queues when the service time has a heavy-tailed distribution.

E-semigroups, product systems and dilation theory

B. V. Rajarama Bhat (bhat@isibang.ac.in),Indian Statistical Institute, Bangalore Centre.

Abstract: E-semigroups are semigroups of endomorphisms of the algebra of all bounded operators on a Hilbert space (or of a general von Neumann algebra). Associated with any such E-semigroup is a tensor product system of Hilbert spaces. E-semigroups can be classified up to cocycle conjugacy through product systems. Product systems have been broadly classified into three types. Non type-I examples were hard to come by, but now we have a plenty of such examples, though we hardly understand them. One may realize E semigroups through dilations of quantum dynamical semigroups. It can be shown that dilations of quantum dynamical semigroups with bounded generators are type I.

Local solvability for linear PDE

Paulo Cordaro, *Instituto de Matemática e Estatística - USP-São Paulo.*

Abstract: In this talk I will survey results concerning local solvability for linear PDE, giving a quick historical background of the subject as well as presenting some very recent results concerning operators with degenerate principal symbols.

Hypersurfaces with prescribed mean curvature

Marcos Dajczer, *IMPA.*

Abstract: I will discuss several recent extensions of a classical result due to J. Serrin on the existence and uniqueness of graphs of constant mean curvature in Euclidean space. The new results deal with graphs of prescribed mean curvature along the flow lines of a Killing field in the ambient Riemannian manifold.

Simultaneous Diophantine approximation with quadratic and linear forms

Shrikrishna G. Dani, ***Tata Institute of Fundamental Research.***

Abstract: By Margulis's theorem proving the Oppenheim conjecture one knows that a quadratic form Q in n > 2 variables which is nondegenerate indefinite and not a multiple of a rational form, takes values near any given real number, over integer n-tuples. We discuss the question of finding such n tuples near a preassigned affine subspace, which corresponds to simultaneous Diophantine approximation involving Q together with a set of linear forms. This is related to the study of dynamics of flows induced by certain diagonalisable one-parameter subgroups on homogeneous spaces of SL(n,R).

The nth power maps of the compactified Jacobian

Eduardo Esteves, *IMPA.*

Abstract: We will present a resolution for the rational nth power maps on the compactified Jacobian of a singular nodal curve.

Multiclass conservative processes, invariant measures and matrix method.

Pablo Ferrari

The coupling of several conservative processes, like the simple exclusion process or the Hammersley process induces multiclass processes. The invariant measures for those processes are connected with the stationary output of a multiclass-customer queue. I will discuss the construction of those measures and the relation with a method coming from Physics to compute the weight of stationary configurations.

"Hardy- Sobolev inequalities"

Adi Murthi, *Tata Institute*, Bangalore

Abstract: Using the Greens function we derive the Hardy-Sobolev type inequalities which covers the classical cases. This method allows to derive it on Manifolds and on Heisenberg group.Further more optimal conditioins are given for the existence of first eigenvalue for the Hardy Sobolev operators.

Varieties defined over number fields

Kapil Hari Paranjape, ***Institute of Mathematical Sciences.***

Abstract: Is there a geometric characterisation of varieties which are defined over number fields? Since there are a number of geometric conjectures that are false unless the variety is defined over a number field, the question becomes interesting. The talk will discuss the paper by the speaker on this topic and some prior and more recent work.

"On Thurston's conjecture on the first Betti number of hyperbolic 3-manifolds"

M.S. Raghunathan, *Tata Institute of Fundamental Research*

Abstract: In this talk we outline an approach to Thurston's conjecture, viz., that any compact hyperbolic 3-dimensional manifold admits a finite cover with non-zero first Betti number. The apprach involves the dynamics of unipotent flows on homogeneouis spaces of SL(2,C).

Ergodic Optimization:
Maximizing Probabilities, Subactions and L.D.P for Gibbs Probabilities

Artur O. Lopes - Inst. Mat. - UFRGS

Let (X, d) be a compact metric space. If $T : X \to X$ is a continuous function, consider $\mathcal{M}_T$ the set of the T-invariant Borel probability measures.

Consider a fixed continuous Holder function $A : X \to \mathbb{R}$. We denote $\beta_A = \max_{\mu \in \mathcal{M}_T} \int A \, d\mu$. In ergodic optimization on compact spaces, the characterization of the invariant probability measures whose integral of A reaches the maximum value β_A is one of the main goals. We call any of these probabilities an A-maximizing probability and denoted it by μ_∞.

We consider the above problem for expanding transformations T of degree d on the circle, or for the shift on the Bernouilli space $\{1, 2, .., d\}^{\mathbb{N}}$.

Given a potential A, an application $u \in C^0(X)$ is a sub-action for A, if $A + u - u \circ T \leq \beta_A$.

The subactions u play the role in discrete time (symbolic dynamics) of the sub-solutions of the Hamilton-Jacobi equations in Classical Mechanics.

One can consider Gibbs states μ_β associated to the potential βA, where $\beta \in \mathbb{R}$. We describe a Large Deviation Principle for $\mu_\beta \to \mu_\infty$, when $\beta \to +\infty$, in the case the maximizing probability μ_∞ is unique. Subactions play an important role in this result.

Recent developments include duality, the W-kernel, holonomic probabilities, results for Markov chains on the interval, Iterated Function Systems and transport in Ergodic Theory.

Homogeneous operators

Gadadhar Misra
Indian Institute of Science

Abstract

A bounded linear operator T is said to be homogeneous if there exists a unitary operator U_φ such that $\varphi(T) = U_\varphi^* T U_\varphi$ for all bi-holomorphic automorphisms φ of the unit disc which are holomorphic in some open neighborhood of the spectrum $\sigma(T)$. If T is irreducible then it is possible to choose a unitary U_φ such that $\varphi \to U_\varphi$ is a projective unitary representation of the automorphism (bi-holomorphic) group of the unit disc. The notion of homogeneity is closely related to the imprimitivity of Mackey. It coincides with it if one assumes that the operator T in question is normal. In general, homogeneity involves a homomorphism of a function algebra rather than a $*$ - homomorphism, as in the case of imprimitivity. We describe all the homogeneous operators of rank n in the Cowen-Douglas class. This is joint work with A. Korányi

On Semilinear Elliptic Systems

Djairo Figueiredo, *Universidade Estadual de Campinas.*

Abstrato: We discuss the existence of solutions for the Dirichlet problem of such systems, using topological methods. We mention the cases when variational methods can be used.

Homogenization in Ergodic Algebras with Applications to Nonlinear Partial Differential Equations

Hermano Frid, *IMPA*

Abstract: In this talk we review the homogenization in ergodic algebras using two-scale Young measures and show some applications to nonlinear partial differential equations such as nonlinear transport and porous medium type equations. The connection of ergodic algebras and realizations of continuous stationary processes in compact spaces will be explained. We also introduce the algebra FSM which strictly contains the almost periodic functions, while keeping some of its important aspects.

Fibers of characters in Harish-Chandra categories

Vyacheslav Futorny, *Instituto de Matemática e Estatística – USP - SP*

Abstract: Extension of characters is a very important problem in Representation Theory, in particular in the study of Harish-Chandra categories. We will discuss this problem for a class of Galois algebras which includes many classical structures such as Generalized Weyl algebras, the universal enveloping algebra of the general linear Lie algebra and some deformations. The talk is based on recent joint results with S.Ovsienko (Kiev) and A.Molev (Sydney).

How to tune the BIC to find the best context tree

Nancy Lopes Garcia, *Universidade Estadual de Campinas.*

Abstract: It has been recently proved that the BIC selects in a consistent way the probabilistic context tree generating a sample. The problem is how to make an optimal choice based only on a finite sample. In this paper we propose an automatic tuning procedure to identify, out from a finite sample, the tree which would emerge asymptotically. This criterium is applied to a real linguistic dataset consisting of written texts of Brazilian and European Portuguese codified according to some basic rhythmic features.

On curves and towers over finite fields

Arnaldo L. P. Garcia, IMPA.

Maximal curves are the ones attaining the famous Hasse-Weil upper bound for the number of rational points on curves over finite fields (Riemann Hypothesis in this context). Ihara has shown that the genus of a maximal curve is upper bounded by half of the cardinality of the finite field, and it is well-known that the Hermitian curve is a maximal curve with the biggest genus possible. Serre has pointed out that subcovers of maximal curves are again maximal, and in particular we get that subcovers of the Hermitian curve are maximal curves. The first example of a maximal curve proven to be not a subcover of the Hermitian curve was found recently by Giulietti and Korchmaros. When we fix the finite field and we consider infinite sequences of curves (the so-called, towers of curves) with increasing genus, then one has that the asymptotic behaviour of the ratios $ (number of rational points) / (genus) $ is upper bounded by the Drinfeld-Vladut bound. We survey on our contributions to maximal curves and to towers of curves over finite fields.

Singularities of analytic plane curves

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Abstract: After the recent solution of the problem of analytic classification of plane branches proposed by Zariski in the seventies, we will present a possible strategy toward the solution of this problem for curves with several branches. In particular, we discuss an important analytic invariant of curves.

Extensions of the Radó theorem.

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Abstract: We discuss extensions of the classical theorem of Radó that asserts that if a continuous function defined on an open set is holomorphic outside the closed set where it vanishes, it is holomorphic everywhere. Viewing holomorphic functions as homogeneous solutions of a system of vector fields, for which other systems their homogeneous solutions will have similar behavior?

A Problem in Probabilistic Combinatorial Number Theory

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Abstract: A celebrated theorem of E. Szemerédi (1975) states that sets of integers with positive upper density contain arbitrarily long arithmetic progressions. This statement for progressions of three elements was established by K.F. Roth (1953).
We may thus say that arithmetic progressions are everywhere within Z: any non-negligible subset of Z cannot avoid them. Are there sparser sets of integers with the same property? In fact, do sparse random sets of integers typically satisfy this property? Together with Luczak and Rödl (1996), we showed that this is the case for progressions of length three, and hence a probabilistic generalization of Roth's theorem holds. A challenging problem is to establish the corresponding result for Szemerédi's theorem.

Meta-stability and condensed zero-range processes on finite sets

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Abstract: We propose a definition o meta-stability and obtain sufficient conditions for a sequence of Markov processes on finite state spaces to be meta-stable. In the reversible case, these conditions reduce to estimates of the capacity and the measure of certain meta-stable sets. We prove that a class of condensed zero-range processes with asymptotically decreasing jump rates is meta-stable.