Svenska matematikersamfundet
The Swedish Mathematical Society

Svenska Matematikkollokviet
The Swedish Mathematical colloquium

Friday, May 29, 2026

Kollokviet äger rum **i Hörsal 6 (Casesal), vån 3, hus 4, Albano,** Stockholms universitet

09.20–10.00	**Gaultier Lambert** (KTH) (Wallenbergpristagare 2025) *On Random Characteristic Polynomials*
10.05–10.30	**Samuel Edwards**(Uppsala) *Counting Circles and Tori*
Kaffepaus	
10.50–11.15	**Anders Karlsson** (Uppsala-Genève) *Some Special Numbers and their Hidden Combinatorics*
11.20–11.45	**Martin Křepela** (Linköping) *Rearrangements in Analysis*
Lunch	
13.00–13.45	**Petter Brändén** (KTH) *Totally Nonnegative Matrices and Real-rooted Polynomials in Combinatorics*
13.50–14.35	**Michael Björklund** (Chalmers) *Hyperuniformity: Yesterday, Today, and Perhaps Tomorrow*
14.40–15.05	**Behnam Esmayli** (Linköping) *Analysis on Metric Spaces, Why and How?*
Kaffepaus	
15.30–16.15	**Kathlén Kohn** (KTH) (Wallenbergpristagare 2025) *Algebraic Neural Network Theory*
16.20–16.45	**Sunghan Kim** (Uppsala) *Constraint Maps and Free Boundaries*
17.00–18:15	**SMS årsmöte**
18:30-22:00	**Middag med annonsering av Wallenbergpristagare 2026** Anmäl senast den 21 maj till **Pavel Kurasov** per e-post **kurasov@math.su.se** om du vill delta i middagen och eventuella allergier.

Hyperuniformity: Yesterday, Today, and Perhaps Tomorrow

Michael Björklund
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will give an overview of the notion of hyperuniformity for point processes, and more generally for random measures and random distributions. First introduced by Torquato and Stillinger in the context of materials physics, hyperuniformity has since developed into an active area of mathematical research.

The talk will survey some recent developments, as well as possible future directions, including results obtained jointly with T. Hartnick (Karlsruhe) and M. Bylehn (Vienna). No prior expertise in point processes will be assumed.

Totally Nonnegative Matrices and Real-rooted Polynomials in Combinatorics

Petter Brändèn
KTH, *pbranden@kth.se*

Several important families of polynomials in combinatorics are known or conjectured to have only real zeros, or to exhibit other related positivity properties. We will survey some of these results, and describe recent results that are derived using properties of totally nonnegative matrices (TN-matrices). The theory of TN-matrices was developed by Gantmacher, Krein, Schoenberg and Karlin, and is still important in linear algebra, statistics, analysis, algebraic combinatorics and physics. This is based on joint work with Leonardo Saud Maia Leite and Lorenzo Vecchi.

Counting Circles and Tori

Samuel Edwards
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We will discuss counting and equidistribution results for locally finite circle packings in the plane which are invariant under a discrete group of Möbius transformation, the most famous of these being Apollonian circle packings. These counting results make use of spectral theory and dynamics on infinite-volume hyperbolic three-manifolds, and I will try to explain a few of the main objects and ideas that go into the proofs of these results. I will also present joint work with Minju Lee and Hee Oh where we use the recently-developed machinery of homogeneous dynamics for Anosov subgroups of higher-rank Lie groups to study analogous questions for torus packings.

Analysis on Metric Spaces, Why and How?

Behnam Esmayli
Linköping, *behnam.esmayli@liu.se*

I explain some of the motivations behind developing analysis on metric spaces. Metric space examples include Euclidean spaces, manifolds, finite and infinite graphs, fractal sets, limits of manifolds, boundaries of other metric spaces, etc. By analysis we mean a theory where one speaks about "a derivative" of a function. A reasonable theory must coincide with the standard structures on the familiar spaces such as the Euclidean spaces and manifolds. I briefly overview several elegantly successful approaches to such a theory, all from the 90's, that have proven extremely fruitful since.

Some Special Numbers and their Hidden Combinatorics

Anders Karlsson
Uppsala-Genève, *anders.karlsson@math.uu.se*

The numbers $\zeta(2) = \pi^2/6$, $\zeta(4) = \pi^4/90$, ... have a famous history and appear in many contexts. The volume of unit spheres 2π, 4π, $2\pi^2$, $8\pi^2/3$, ... are fundamental and ancient. These numbers are usually understood through limits. In this talk, we present a new spectral and discrete framework that reveals the combinatorial structure of these special numbers, as well as all corresponding values of Dirichlet L-functions. Remarkably, they can in this way be evaluated by simple counting on the simplest of graphs. This also connects to other scientific areas, especially physics, but even to the study of water systems. Joint work with Müller, Pallich, Jorgenson and Smajlović.

Constraint Maps and Free Boundaries

Sunghan Kim
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Constraint maps arise as minima of the Dirichlet energy under image constraints, which can be considered a natural extension of the obstacle problem into a vectorial setting. The presence of the obstacle gives rise to a free boundary, which is the interface between the contact and non-contact sets in the domain. As the simplest example, one can consider a geodesic connecting two prescribed points but constrained to lie outside a given open set. In this case, the closure of the open set is the obstacle, and the free boundary is given by the points where the geodesic enters and exits the obstacle. This is the problem for a 1-dimensional domain, but the target can be of any dimension. For two-dimensional domains, the problem already becomes interesting as it produces minimal surfaces with obstacles. For three- or higher-dimensional domains, the problem becomes significantly more challenging as it gives rise to singularities that have rarely been studied in the context of a free boundary problem. Historically, this problem was studied from the perspectives of harmonic maps and minimal surfaces, yet it left a fundamental issue open for decades concerning the interplay between the singularities and the free boundaries. This open problem was resolved recently by my collaborators and me, using a set of new approaches based on insights from free boundary problems. In this talk, I will give some examples of constraint maps in several different dimensions and show under which circumstances the free boundary can repel or embrace the singularities. The talk will be based on recent joint work with Alessio Figalli (ETH), André Guerra (Cambridge), and Henrik Shahgholian (KTH).

Algebraic Neural Network Theory

Kathlén Kohn
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The space of functions parametrized by a fixed neural network architecture is known as its "neuromanifold", a term coined by Amari. Training the network means to solve an optimization problem over the neuromanifold. Thus, a complete understanding of its intricate geometry would shed light on the mysteries of deep learning. This talk explores the approach to approximate neural networks by algebraic ones that have semialgebraic neuromanifolds. In this setting, we can interpret training the network as finding a "closest" point on the neuromanifold to some data point in the ambient space. In particular, this perspective enables us to see that the singularities (and boundary points) of the neuromanifold can cause a tradeoff between efficient optimization and good generalization to unseen data. We discuss several conjectures on singularities and hidden parameter symmetries (i.e., fibers) of neuromanifolds. This talk will focus on 3 popular architectures: multilayer perceptrons, convolutional networks, and self-attention networks that are the key ingredient of large language models like ChatGPT. The results presented in this talk are based on several joint works with Paul Breiding, Erin Connelly, Nathan Henry, Giovanni Marchetti, Stefano Mereta, Vahid Shahverdi, and Matthew Trager.

Rearrangements in Analysis

Martin Křepela
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The talk will start with revisiting the Gale-Ryser theorem, a result from the 1950's concerning reconstruction of a matrix from the sums of its rows and columns. We may then compare it to an analogue for two-dimensional sets and their horizontal and vertical cross-sections. In both settings, the concept of rearrangement appears, concerning either a function or a sequence. I will show how the monotone rearrangement of a function is constructed, and where it is useful in various areas of functional analysis.

On Random Characteristic Polynomials

Gaultier Lambert
KTH, *glambert@kth.se*

In recent works with E. Paquette (McGill University), we study the asymptotics of the characteristic polynomial of a certain random tri-diagonal matrix model called the Gaussian β-ensemble (GβE) or Dumitriu-Edelman model. Because of the tri-diagonal structure, there is a connection to orthogonal polynomials and the characteristic polynomial can be viewed as a perturbation of the Hermite polynomials, the orthogonal polynomial with respect to a Gaussian measure on $\mathbb{R}$. In this talk, I will present this classical random matrix model, the relationships with Hermite polynomials and the semicircle law and our asymptotic approximations for the characteristic polynomial. I will focus on explaining the model and the meaning of our results, the proofs which rely on technical probabilistic arguments and will not be discussed.