

Interactions between Combinatorics, Analysis and Statistical Physics

University College London

Monday 22nd June 2026

Time	Speaker	Title of talk
9:20–9:30	Welcome and Opening remarks	
9:30–10:00	Jiang Zeng (Virtual)	Continued fractions in enumerative combinatorics: Examples and methods
10:00–10:30	Vincent Rivasseau (In person)	Variational loop vertex expansion for cumulants
10:30–11:00	Xi Chen (Virtual)	Palindromic polynomials with alternating gamma coefficients
11:00–11:30	Tea break	
11:30–12:00	Bao-Xuan Zhu (Virtual)	Total positivity of combinatorial matrices
12:00–12:30	Olga Holtz (In person)	
12:30–13:15	Natasha Blitvić + Einar Steingrímsson (Virtual)	Patterns, posets, probability
13:15–14:45	Lunch break	
14:45–15:45	Petter Brändén (Virtual)	Totally nonnegative matrices and zeros of polynomials
15:45–16:15	Tea break	
16:15–17:15	Richard Stanley (Virtual)	Sprout symmetric functions
17:15–18:15	Bishal Deb (In person)	Coefficientwise Hankel total positivity: a survey

Tuesday 23rd June 2026

Time slot	Speaker	Title of talk
9:30–10:00	Tim Garoni (Virtual)	Berry-Esseen bounds for the high-temperature Ising model with free and periodic boundary conditions
10:00–10:30	Youjin Deng (Virtual)	Random walks and critical phenomena in long-range interacting systems
10:30–11:00	Aernout van Enter (In person)	One-sided versus two-sided Gibbs properties
11:00–11:30	Tea break	
11:30–12:00	Jean Bricmont (Virtual)	Quantum mechanics explained to Alan
12:00–12:30	Tony Guttmann (In person)	k -convex polyominoes enumerated by semi-perimeter and area
12:30–14:30	Lunch Break	
14:30–15:30	Lauren Williams (Virtual)	Total positivity and signed variants coming from cluster algebras
15:30–16:00	Jesper Jacobsen (Virtual)	Correlation functions in two-dimensional critical loop models
16:00–16:30	Andrea Pelissetto (Virtual)	Crossing first-order transition: dynamic out-of-equilibrium percolation transitions
16:30–17:00	Tea break	
17:00–17:30	Roberto Fernandez (Virtual)	Math. Stat. Mech. and Alan's travels through the phase diagram
17:30–18:00	Robert Edwards (Virtual)	Fields, groups and graphs — life on the lattice
18:00–18:30	Tereza Mendes (Virtual)	
19:30–	Conference Dinner: Chutney's — 124 Drummond Street, Euston, London NW1 2PA England	

Wednesday 24th June 2026

Time slot	Speaker	Title of talk
9:30–10:30	Guus Regts (In person)	Complex zeros of the partition function of the hard-core model and the chromatic polynomial
10:30–11:00	Gordon Royle (Virtual)	Real chromatic roots of planar triangulations are dense in the interval $(3, 4)$?
11:00–11:30	Tea break	
11:30–12:00	Bill Jackson (In person)	Chromatic zeros
12:00–12:30	Gaurav Bhatnagar (Virtual)	The method of telescoping continued fractions
12:30–13:00	Veronica Bitonti (In person)	Thron-type continued fractions for some classes of increasing trees
13:00–14:30	Lunch break	
14:30–15:30	Andrea Sportiello (In person)	The unsuspected combinatorics of the Euclidean Assignment Problem
15:30–16:00	Tea break	
16:00–16:30	Anna Vishnyakova (Virtual)	Totally positive sequences generated by real polynomials
16:30–17:00	Jesús Salas (In person)	Graham–Knuth–Patashnik recurrences: Jacobi-type continued fractions and Hankel-total positivity
17:00–17:30	Neal Madras (Virtual)	Self-avoiding walks: An eclectic survey
	Closing remarks by Alan Sokal	

Abstracts

Speaker: Jiang Zeng (Wenzhou University and Université Lyon 1)

Title: Continued fractions in enumerative combinatorics: examples and methods

Abstract: In this talk, I will survey some typical appearances of continued fractions in enumeration and discuss several methods for proving them: lattice paths and weighted Motzkin paths, ordinary generating functions, bijective proofs via permutation statistics, production matrices, Hankel determinants, and connections with orthogonal polynomials.

Particular emphasis will be placed on the way continued fractions transform complicated enumeration problems into local weights on paths. This point of view explains many positivity phenomena, such as coefficientwise positivity, gamma-positivity and total positivity, and also provides a useful bridge between permutation statistics, q -analogues, and classical families of orthogonal polynomials.

Speaker: Vincent Rivasseau (Université Paris-Saclay)

Title: Variational loop vertex expansion for cumulants

Abstract: Extending recent advances on constructive quantum field theory, we study cumulants of one of the simplest matrix models in the regime of bounded rank. We analyze both ordinary cumulants and scalar cumulants, which arise from the Weingarten calculus and are essential to the topological expansion in quantum field theory. Our results are valid for arbitrarily large positive coupling and provide new instances where techniques such as the variational approach are applied to cumulants.

Speaker: Xi Chen (Dalian University of Technology)

Title: Palindromic polynomials with alternating gamma coefficients

Abstract: In this talk, we study palindromic polynomials whose gamma coefficients alternate in sign, which are called gamma-alternating polynomials. We present criteria for such polynomials from the perspective of zero distribution and recurrences, respectively. We also investigate operators that preserves the gamma-alternating property of polynomials. As applications, certain known results can be obtained and extended in a unified approach.

Speaker: Bao-Xuan Zhu (Jiangsu Normal University)

Title: Total positivity of combinatorial matrices

Abstract: Total positivity is a powerful concept and has many applications in many branches of mathematics. In this talk, we will introduce some results for total positivity in combinatorics.

Speaker: Olga Holtz (University of California Berkeley)

Title:

Abstract:

Speakers: Natasha Blitvić (Queen Mary University of London) + Einar Steingrímsson (University of Strathclyde)

Title: Patterns, posets, probability

Abstract: We count permutations covered by regularly overlapping occurrences of any given consecutive pattern. We conjecture that, with slight modifications, all the enumeration sequences arising are moments of probability measures on the real line, and prove this for several classes of such patterns.

Each set of permutations thus covered by a given number of occurrences of a pattern coincides with the set of linear extensions of a poset defined in terms of the pattern and overlap in question. We also describe several structural properties of these posets, and characterize those patterns whose corresponding Hasse diagrams are trees or grids, that is, subsets of the integer lattice with additional elements between lattice points.

Speaker: Petter Brändén (KTH Royal Institute of Technology)

Title: Totally nonnegative matrices and zeros of polynomials

Abstract: We associate families of univariate polynomials to any unitriangular matrix. When the matrix is totally nonnegative, then the polynomials are proven to be real-rooted. When the matrix comes from a poset, then these polynomials are known as chain polynomials and Chow polynomials. In this setting our results prove new cases of conjectures regarding real-rootedness of such polynomials. This is based on joint work with Leonardo Saud Maia Leite and Lorenzo Vecchi.

Speaker: Richard Stanley (Massachusetts Institute of Technology, USA)

Title: Sprout symmetric functions

Abstract: We will discuss certain sequences (R_0, R_1, \dots) of symmetric functions that we call *sprout symmetric functions*. Many examples of sprout symmetric functions have already appeared in the literature, connected with such topics as the symmetric function generalization of the Tutte polynomial of a graph, Hirzebruch's L-genus, and zeta polynomials of binomial posets. We first consider basic properties of sprout symmetric functions, in particular, their expansion into classical bases for symmetric functions. Especially interesting are the expansions into Schur, elementary, and complete homogeneous symmetric function, which are closely related to the Edrei-Thoma theorem from the theory of total positivity. We conclude with some examples related to alternating permutations and their generalizations.

Speaker: Bishal Deb (Tsinghua University)

Title: Coefficientwise Hankel total positivity: a survey

Abstract: Coefficientwise Hankel total positivity is an algebraic upgrading of the Stieltjes moment property. In this talk, I will present a survey of this new area. I will discuss some of the main techniques to prove these results and along with some important results. This talk will consist of many conjectures.

Speaker: Tim Garoni (Monash University)

Title: Berry-Esseen bounds for the high-temperature Ising model with free and periodic boundary conditions

Abstract: We consider the nearest-neighbour Ising model on finite boxes in \mathbb{Z}^d , in the high-temperature regime. We establish sharp Berry-Esseen bounds on the distance between the laws of the Ising magnetisation and a corresponding normal random variable, in terms of the number of spins. In particular, we show that for $d \geq 3$, the rate of convergence is asymptotically slower for free boundary conditions than for periodic boundary conditions. The proof is based on Stein's method, and involves analysing the semigroup of the continuous-time Glauber (heat-bath) process.

Speaker: Youjin Deng (University of Science and Technology of China)

Title: Random walks and critical phenomena in long-range interacting systems

Abstract: The Ising and $O(n)$ spin models are fundamental systems in statistical and condensed matter physics. For short-range-interacting cases, the nature of their phase transitions is well established by renormalization-group theory. However, when algebraically decaying long-range interactions $\sim 1/r^{(d+\sigma)}$ are introduced—where d is the dimensionality and σ is the decaying exponent, the universality class of the transitions in these models remains elusive. Building on the geometric scaling of long-range random walks, we propose a simple universality diagram in the (d, σ) plane for the critical phenomena of the $O(n)$ spin model. The conjectured universality diagram is consistent with recent high-precision numerical studies, rigorous mathematical proofs, and perturbative field-theoretical calculations. Generalizations to other systems, including long-range quantum models, are also achieved, offering a unified perspective on critical phenomena in systems with long-range interactions.

Speaker: Aernout van Enter (University of Groningen)

Title: One-sided versus two-sided Gibbs properties

Abstract: I discuss two examples, illustrating that one-sided and two-sided Gibbs properties (continuity) are not equivalent, nor does one imply the other one.

Speaker: Jean Bricmont (Université Catholique de Louvain)

Title: Quantum mechanics explained to Alan

Abstract: I will explain why the de Broglie-Bohm theory solves the apparent mysteries and paradoxes of quantum mechanics.

Speaker: Tony Guttmann (University of Melbourne)

Title: k -convex polyominoes enumerated by semi-perimeter and area.

Abstract: We give the conjectured solution for the generating function of k -convex polyominoes, enumerated by semi-perimeter. The solution was obtained from the analysis of enumeration data that we generated. The conjectured asymptotic form for enumeration by area is also given.

Speaker: Lauren Williams (Harvard University)

Title: Total positivity and signed variants coming from cluster algebras

Abstract:

Speaker: Jesper Jacobsen (École Normale Supérieure)

Title: Correlation functions in two-dimensional critical loop models

Abstract: Using a combination of lattice algebra and conformal bootstrap methods we determine correlation functions of critical loop models in various geometries. Examples include the probability that three given points are on the same loop in the sphere geometry, the probability that the loop passing through one given point is non-trivial in the torus geometry, or the probability that two given points are not separated by any loop in the disc geometry with free or wired boundary conditions. We discuss the perspectives of going beyond such specific examples and setting up the principles for determining all geometric correlation functions in critical loop models.

Speaker: Andrea Pelissetto (Università di Roma Sapienza)

Title: Crossing first-order transition: dynamic out-of-equilibrium percolation transitions

Abstract: I review recent work aimed at elucidating the dynamic behavior of metastable states in systems exhibiting first-order transitions. The main result is the characterization of the phase-flip process as a dynamic percolation transition. However, the inherently out-of-equilibrium nature of the dynamics leads to features that differ from those observed at the standard random-percolation percolation transition.

I will mainly focus on the paradigmatic two-dimensional Ising model subject to a heat-bath local dynamics that drives the system across the low-temperature first-order transition line. However, preliminary work shows that a qualitatively similar behavior is obtained for different dynamic protocols, different models (we investigated the Potts model) and in higher dimensions.

Speaker: Roberto Fernandez (New York University Shanghai)

Title: Math. Stat. Mech. and Alan's travels through the phase diagram

Abstract: The talk will present a quick introduction to statistical mechanics and its mathematical formulation, with emphasis on lattice spin models. These are regular arrays (lattices) of objects (spins, pixels, ...) subjected to interactions that determine the energy of the ensemble. I will introduce the relevant mathematical notions and describe the phenomena of phase transitions, critical points and the resulting phase diagram. This description will give me the opportunity to highlight Alan's contributions to the rigorous understanding of the different regions of the phase diagram.

Speaker: Robert Edwards (Thomas Jefferson National Accelerator Facility)

Title: Fields, groups and graphs — life on the lattice

Abstract: I present an overview of mathematical aspects of lattice gauge theories.

Speaker: Tereza Mendes (Universidade de São Paulo)

Title:

Abstract:

Speaker: Guus Regts (University of Amsterdam)

Title: Complex zeros of the partition function of the hard-core model and the chromatic polynomial.

Abstract: In this talk I will survey several recent results on the location/absence of complex zeros of the partition function of the hard-core model (aka the independence polynomial) and the chromatic polynomial. Traditionally the motivation for studying these zeros comes from statistical physics. I will discuss why there is motivation from theoretical computer science to study these zeros.

Speaker: Gordon Royle (University of Western Australia)

Title: Real chromatic roots of planar triangulations are dense in the interval $(3, 4)$?

Abstract: Let $P(G, q)$ denote the chromatic polynomial of the graph G , i.e., the function that counts the number of proper q -colourings of G when q is a positive integer. For many years researchers have investigated the location of the roots - integer, real or complex - of the chromatic polynomials of various families of graphs. Although Alan resolved the two biggest open questions on complex chromatic roots around 25 years ago, there are still many questions on real chromatic roots that remain open. In this talk, I will be focussing on one small question regarding the real chromatic roots of planar triangulations, in particular whether these roots are dense in the interval $(3, 4)$. The answer is (almost) certainly yes, but for more than 15 years I have been unable to fill in a final crucial detail of the proof. Thus I find myself in the unusual situation where, rather than presenting a proof to the audience, I am very much hoping that the combined expertise of this particular audience can present a proof to me.

Speaker: Bill Jackson (Queen Mary University of London)

Title: Chromatic zeros

Abstract: I will survey results on the zero distribution of chromatic polynomials and their relatives.

Speaker: Gaurav Bhatnagar (Ashoka University)

Title: The method of telescoping continued fractions

Abstract: We give an approach to discover continued fractions for series in the form

$$\sum_{k=1}^{\infty} \frac{\epsilon^k}{(x+k)^s},$$

where $\epsilon = \pm 1$. We find a continued fraction of the form

$$\frac{a_1}{b_1(x)} + \frac{a_2}{b_2(x)} + \dots$$

where a_i are constants and $b_i(x)$ are polynomials. Our technique involves telescoping continued fractions.

This provides a discovery approach to continued fractions given by Ramanujan for

$$2 \sum_{k=1}^{\infty} \frac{(-1)^{k+1}}{x+2k-1}, 2 \sum_{k=0}^{\infty} \frac{1}{(x+2k+1)^2}, 2 \sum_{k=0}^{\infty} \frac{(-1)^k}{(x+2k+1)^2}, \sum_{k=1}^{\infty} \frac{1}{(x+k)^3},$$

and the like.

We display the first few terms of the continued fractions obtained when $s = 5$ and 7 . An intriguing unsolved problem is to find the general term of these continued fractions. These do not follow as simple a pattern as Ramanujan's continued fractions.

This is joint work with Krishnan Rajkumar.

Speaker: Veronica Bitonti (University of Oxford)

Title: Thron-type continued fractions for some classes of increasing trees

Abstract: We first describe the reverse-engineering approach that led us to formulate our conjecture. We then introduce some classes of increasing labeled and multilabeled trees, and show that they provide combinatorial interpretations for certain Thron-type continued fractions with coefficients that are quasi-affine of period 2. Our proofs are based on bijections from trees to labelled Motzkin or Schröder paths; these bijections extend the well-known bijection of Françon–Viennot (1979) interpreted in terms of increasing binary trees. This is a joint work with Bishal Deb and Alan Sokal.

Speaker: Andrea Sportiello (LIPN, Université Sorbonne Paris Nord and CNRS)

Title: The unsuspected combinatorics of the Euclidean Assignment Problem

Abstract: In this talk we review some of our recent results (and conjectures) on the Optimal Matching and Assignment Problems. Which, of course, are in disguise the zero-temperature Statistical Mechanics of a disordered Dimer Model. Surprisingly, a suitable twist of the natural framework leads to the emergence of certain spanning trees, instead of dimer configurations (and no, this is not just the Temperley bijection). Our ultimate (but still unreached) goal is to show that, in the uniform Euclidean Random Assignment Problem, these trees are Uniform Spanning Trees in the thermodynamic limit, and thus that certain curves associated to this process are (radial) SLE curves at $\kappa = 2$.

Speaker: Anna Vishnyakova (Holon Institute of Technology)

Title: Totally positive sequences generated by real polynomials

Abstract: A sequence of nonnegative numbers $(a_k)_{k=0}^\infty$ is called totally positive, if all minors of the infinite matrix

$$\begin{pmatrix} a_0 & a_1 & a_2 & a_3 & \dots \\ 0 & a_0 & a_1 & a_2 & \dots \\ 0 & 0 & a_0 & a_1 & \dots \\ \vdots & \vdots & \vdots & \vdots & \ddots \end{pmatrix}$$

are non-negative.

Concept of total positivity found numerous applications and was studied from many different sides. It has applications in distribution of zeros of polynomials and entire functions, Pólya frequency sequences, unimodality and log-concavity, stochastic processes and approximation theory, mechanical systems, planar networks, combinatorics and representation theory.

Let $P, P(0) > 0$, be a real polynomial of degree m . It is easy to check that $\sum_{k=0}^\infty P(k)x^k = \frac{Q(x)}{(1-x)^{m+1}}$, where Q is a real polynomial of degree at most m .

We will discuss the following problem: for which P the sequence $(P(k))_{k=0}^\infty$ is totally positive? Due to the famous theorem by Aissen, Schoenberg, Whitney and Edrei it happens if and only if all the zeros of Q are real and non-positive.

Speaker: Jesús Salas (Universidad Carlos III de Madrid)

Title: Graham–Knuth–Patashnik recurrences: Jacobi-type continued fractions and Hankel-total positivity

Abstract: In this talk, we will consider the Graham–Knuth–Patashnik (GKP) recurrences given by

$$T(n, k) = (n\alpha + k\beta + \gamma)T(n-1, k) + (n\alpha' + k\beta' + \gamma')T(n-1, k)$$

for $n \geq 1$ and $k \in \mathbb{Z}$ with the initial condition $T(0, k) = \delta_{k,0}$. Given the parameter $\boldsymbol{\mu} = (\alpha, \beta, \gamma, \alpha', \beta', \gamma')$, the GKP recurrence defines the triangular array $(T(n, k))_{n,k \geq 0}$, the sequence $(P_n(x; \boldsymbol{\mu}))_{n \geq 0}$ of row-generating polynomials $P_n(x; \boldsymbol{\mu}) = \sum_{k \geq 0} T(n, k)x^k$, and the ordinary generating function (ogf) $f(x, t; \boldsymbol{\mu}) = \sum P_n(x)t^n$.

The main goal is to characterize those recurrences $\boldsymbol{\mu}_i$ whose ogf $f(x, t; \boldsymbol{\mu}_i)$ has a representation in terms of a Jacobi-type continued fraction with coefficients γ_k, β_k that are polynomials in the indeterminate x . We find that there are exactly 16 families $\boldsymbol{\mu}_i$ such that this representation exists. In all cases, the coefficients γ_k, β_k are polynomials in x and in the parameters appearing in $\boldsymbol{\mu}_i$.

The second goal is to show that the sequence of row-generating polynomials $(P_n(x; \boldsymbol{\mu}_i))_{n \geq 0}$ is coefficient-wise Hankel-totally positive in x and in the parameters appearing in $\boldsymbol{\mu}_i$ for 11 of these families.

Speaker: Neal Madras (York University)

Title: Self-avoiding walks: an eclectic survey

Abstract: A self-avoiding walk is a finite path in a regular lattice that does not revisit any site. Self-avoiding walks arise in statistical physics as models of linear polymer molecules, for example. This talk will introduce the mathematical theory of large self-avoiding walks and related models, describing what we can prove about their asymptotic enumeration and what we cannot. Of particular importance are the “critical exponents,” the next-to-leading-order terms in the asymptotic expressions, which capture the physical behaviour of the system being modelled. While physicists understand critical exponents fairly well, they pose formidable challenges for rigorous mathematics.