Spring School Complex Networks

March 2 – 6, 2020

TU Darmstadt

Short Courses
Frank den Hollander
Remco van der Hofstad

Invited Speakers
Luca Dall'Asta
Maria Deijfen
James Gleeson
Marc Lelarge
Nicos Starreveld
Tiziano Squartini

Organization
Frank Aurzada
Volker Betz
Heinz Köppl
Matthias Meiners

February 26, 2020

Contents

1 General Information

1.1 Accommodation

The participants are recommended to stay in one of the following hotels, located in walking distance (15 minutes) to the lecture venue.

HOTEL BOCKSHAUT
Kirchstraße 7-9, 64283 Darmstadt
Tel: +49-6151-9967-0 info@bockshaut.de

HOTEL WELCOME
Karolinenplatz 4, 64289 Darmstadt
Tel: +49-6151-3914-0 info.dar@welcome-hotels.com

HOTEL ATLANTA
Kasinostraße 129, 64293 Darmstadt
Tel: +49-6151-1789-0 info@hotel-atlanta-darmstadt.de

For directions please see the map on the back cover.

1.2 Registration

On Monday morning, starting from 8:00, registration is possible in the lobby of the lecture hall.

1.3 Lecture Hall

Location: Technische Universität Darmstadt. The registration and all lectures will take place in building S2|04, Hochschulstraße 8, 64289 Darmstadt in lecture hall S2|04/213. In the lecture hall, there are 2 large blackboards, 2 small blackboards and a projector.

1.4 Map & Points of Interest

The map can be found on the back cover.

1.5 Public Transportation

The closest bus and tram stops to the venue of the workshop are **Schloss** (trams: S2, S3, S9) and **Willy-Brandt-Platz** (trams: S4, S5, S6, S7, S8). Both stops are within 10 minutes walking distance to the lecture hall.

1.6 Food & Beverage

Cheap and plain food can be purchased at the TU Darmstadt Refectory-Canteen, Alexanderstr. 4, building S1|11, Monday to Friday 11:15 to 14:00. Additionally there are lots of good restaurants and bistros near TU Darmstadt. Please dial +49 6151 preceding the number given below.

Name	Address	Phone	Cuisine	Opening Hours
Ratskeller	Marktplatz 8	26444	German	10:00 - 01:00
Pizzeria da Nino	Alexanderstr. 29	24220	Italian	18:00 - 23:00
Haroun's	Friedensplatz 6	23487	Oriental	11:00 - 22:30
Vis à Vis	Fuhrmannstr. 2	8058339	Bistro	12:00 - 15:00
Cafe Extrablatt	Marktplatz 11	5998820	Bistro	08:30 - 23:30
Ristorante Sardegna	Kahlertstraße 1	23029	Italian	11:30 - 14:45

1.7 Conference Dinner

On Tuesday, March 3rd 2020, there will be a conference dinner at the Restaurant *Bockshaut*, Kirchstraße 7-9, 64283 Darmstadt, Tel: +49-6151-9967-0 info@bockshaut.de

1.8 Free Afternoon

On Wednesday, March 4th 2020, there will be a free afternoon.

1.9 Contact Information

If you have any questions concerning the workshop, please feel free to contact one of the local organizers or the technical support:

- Prof. Dr. Frank Aurzada
  Office: S2-15, Room 341
  Phone: +49 6151 - 16 23375
- Prof. Dr. Volker Betz
  Office: S2-15, Room 340
  Phone: +49 6151 - 16 23370
- Office Department
  Office: S2-15, Room 339
  Phone:+49 6151 - 16 23380 or - 16 23378
- springschool@mathematik.tu-darmstadt.de

Acknowledgements

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TECHNISCHE UNIVERSITÄT DARMSTADT

Fachbereich **Mathematik**

SFB 1053

INTERNET AND DIGITISATION

Goethe-Universität Frankfurt am Main
Johannes Gutenberg-Universität Mainz
Technische Universität Darmstadt
Eine strategische Allianz
Rhein-Main Universitäten

Time	Monday	Tuesday	Wednesday	Thursday	Friday
08:00	Registration				
09:00	van der Hofstad	den Hollander	van der Hofstad	van der Hofstad	Invited talk: Dall’Asta
	Coffee break	*Coffee break*	*Coffee break*	*Coffee break*	Invited talk: Squartini
	den Hollander	den Hollander	den Hollander	den Hollander	*Coffee break*
			Coffee break	*Coffee break*	
		Invited talk: Starreveld	den Hollander	den Hollander	Invited talk: Lelarge
	Lunch	*Lunch*	*Lunch*	*Lunch*	*Lunch*
14:00	van der Hofstad	van der Hofstad	*Free Afternoon* *Excursion*	Invited talk: Gleeson	*End of Workshop*
	Coffee break	*Coffee break*		*Coffee break*	
16:00	Short talks: Fernley Langhammer Andreis Lodewijks Schmid Thomas Holbach	Invited talk: Deijfen		Short talks: Nargang Iyer Mühlbacher van Waaij Alarfaj Tóbiás Nuermaimaiti El Masmari	
	Reception	Dinner			

Monday, 2 March 2020

Time	Speaker	*Title of Talk*
09:00-09:05	Welcome	
09:05-10:35	Remco van der Hofstad	*Mini course: Small-worlds, complex networks and random graphs* *Lecture 1: Real-world networks and random graphs*
10:35-11:00		–Coffee break–
11:00-12:30	Frank den Hollander	*Mini course: Dense Random Graphs* *Introduction to dense graphs and graphons*
12:30-14:00		–Lunch break–
14:00-15:30	Remco van der Hofstad	*Mini course: Small-worlds, complex networks and random graphs* *Lecture 2: Local weak convergence: theory*
15:30-16:00		–Coffee break–
16:00-16:10	Short talk	John Fernley
16:10-16:20	Short talk	Heide Langhammer
16:20-16:30	Short talk	Luisa Andreis
16:30-16:40	Short talk	Bas Lodewijks
16:40-16:50	Short talk	Dominic Schmid
16:50-17:00	Short talk	Sam Thomas
17:00-17:10	Short talk	Simon Holbach
17:10-17:20	Short talk	Mohamed Ali Hammami
17:30-23:00	Reception	–Cheese & Wine–

Tuesday, 3 March 2020

Time	Speaker	*Title of Talk*
09:00-10:00	Frank den Hollander	*Mini course: Dense Random Graphs* *Breaking of ensemble equivalence for constrained graphons I*
10:00-10:30		–Coffee break–
10:30-11:30	Frank den Hollander	*Mini course: Dense Random Graphs* *Breaking of ensemble equivalence for constrained graphons II*
11:30-12:30	*Invited talk* Nicos Starreveld	 *Large deviations and the Erdös-Rényi random graph*
12:30-14:00		–Lunch break–
14:00-15:30	Remco van der Hofstad	*Mini course: Small-worlds, complex networks and random graphs* *Lecture 3: Local weak convergence of random graphs*
15:30-16:00		–Coffee break–
16:00-17:00	*Invited talk* Maria Deijfen	 *Competing growth on lattices and graphs*
18:30-22:00	Conference Dinner	–Restaurant Bockshaut–

Wednesday, 4 March 2020

Time	Speaker	*Title of Talk*
09:00-10:30	Remco van der Hofstad	*Mini course: Small-worlds, complex networks and random graphs* *Lecture 4: The giant in random graphs is almost local*
10:30-10:45		–Coffee break–
10:45-11:45	Frank den Hollander	*Mini course: Dense Random Graphs* *Spectra of graphons I*
11:45-12:00		–Coffee break–
12:00-13:00	Frank den Hollander	*Mini course: Dense Random Graphs* *Spectra of graphons II*
13:00-14:30		–Lunch break–

–Free afternoon – Excursion–

Thursday, 5 March 2020

Time	Speaker	*Title of Talk*
09:00-10:30	Remco van der Hofstad	*Mini course: Small-worlds, complex networks and random graphs* *Lecture 5: Small-world structure of random graphs*
10:30-10:45		–Coffee break–
10:45-11:45	Frank den Hollander	*Mini course: Dense Random Graphs* *Dynamics of graphons I*
11:45-12:00		–Coffee break–
12:00-13:00	Frank den Hollander	*Mini course: Dense Random Graphs* *Dynamics of graphons II*
13:00-14:30		–Lunch break–
14:30-15:30	*Invited talk* James Gleeson	 *Branching processes as models of cascade dynamics on networks*
15:30-16:00		–Coffee break–
16:00-16:10	Short talk	Stephanie Nargang
16:10-16:20	Short talk	Tejas Iyer
16:20-16:30	Short talk	Peter Mühlbacher
16:30-16:40	Short talk	Jan van Waaij
16:40-16:50	Short talk	Boshra Alarfaj
16:50-17:00	Short talk	András Tóbiás
17:00-17:10	Short talk	Ruheyan Nuermaimaiti
17:10-17:20	Short talk	Soukaina El Masmari

Friday, 6 March 2020

Time	Speaker	*Title of Talk*
09:00-10:00	*Invited talk* Luca Dall'Asta	*Inverse problems in epidemic dynamics*
10:00-11:00	*Invited talk* Tiziano Squartini	*Maximum-entropy models for networks*
11:00-11:30		–Coffee break–
11:30-12:30	*Invited talk* Marc Lelarge	*A statistical physics approach to learning for complex networks*
12:30-14:00		–Lunch break, End of the Spring School–

2 List of Talks

2.1 Short Courses

Frank den Hollander
Leiden University, Netherlands
Mini course: Dense Random Graphs

For $n \in \mathbb{N}$, let G_n be a random graph on n vertices. A sequence $(G_n)_{n\in\mathbb{N}}$ is called *dense* if the degrees of G_n are of order n as $n \to \infty$. Each G_n can be represented by its *adjacency matrix* A^{G_n}, defined by

$$A^{G_n}(i,j) = 1_{\{\text{vertices } i \text{ and } j \text{ are connected by an edge}\}}, \quad i,j \in [n] = \{1,\dots,n\}.$$

The latter can in turn be represented by its *graphon* h^{G_n}, defined by

$$h^{G_n}(x,y) = 1_{\{\text{vertices } \lceil nx \rceil \text{ and } \lceil ny \rceil \text{ are connected by an edge}\}}, \quad x,y \in [0,1].$$

Each h^{G_n} is an element of the *space of graphons*

$$\mathscr{W} = \{h\colon [0,1]^2 \to [0,1] \text{ symmetric}\}.$$

If $\lim_{n\to\infty} h^{G_n} = h$, then we say that the sequence $(G_n)_{n\in\mathbb{N}}$ has graph limit h. If the vertices are not labelled, then we need to slice up $\mathscr{W}$ into *equivalence classes* via measure-preserving bijections of $[0,1]$, corresponding to permutations of the vertex labels. The resulting set of equivalence classes $\widetilde{\mathscr{W}}$ is endowed with a metric called the *cut-metric*. Convergence in the cut-metric is equivalent to convergence of all subgraphs densities, which is why graphons capture all the *local characteristics* of the graph limit.

The mini-course consists of four topics:
(1) Introduction to dense graphs and graphons (1.5 hour).
(2) Breaking of ensemble equivalence for constrained graphons (2 hours).
(3) Spectra of graphons (2 hours).
(4) Dynamics of graphons (2 hours).

The material presented is based on joint work with Siva Athreya (Bangalore), Arijit Chakrabarty (Kolkata), Rajat Hazra (Kolkata), Michel Mandjes (Amsterdam), Andrea Roccaverde (Leiden), Adrian Röllin (Singapore), Matteo Sfragara (Leiden), Nicos Starreveld (Amsterdam).

Remco van der Hofstad
Eindhoven University of Technology, Netherlands
Mini course: Small-worlds, complex networks and random graphs

Empirical findings have shown that many real-world networks share fascinating features. Indeed, many real-world networks are small worlds, in the sense that typical distances are much smaller than the size of the network. Further, many real-world networks are scale-free, in the sense that there is a high variability in the number of connections of the elements of the networks making them highly inhomogeneous.
Spurred by these empirical findings, many models have been proposed for such networks. In this lecture series, we discuss empirical findings of real-world networks, and describe some of the random graph models proposed for them. In particular, we will discuss the classical Erdös-Rényi random graph, and then move to the more relevant configuration model, generalized random graphs and preferential attachment models, as well as some extensions of them.
We introduce the notion of local weak convergence, and discuss the theory behind it. We then discuss local weak convergence in random graphs, and its relation to branching process approximations in, or the locally tree-like nature of, random graphs. While local weak convergence is related to the local structure around typical vertices in random graphs, it also has implications for many global quantities such as the giant component and small-world properties of random graphs. In general, many global properties can be predicted from similar properties of the branching process local limit of the model. For example, we show how the statement that the "giant component is almost local" can be made precise. We close by discussing the small-world phenomenon in these random graph models, its link to "six degrees of separation" as well as how these distances can be understood in more detail using the branching process approximation.

A rough outline of the lecture series is as follows:
Lecture 1: Real-world networks and random graphs
Lecture 2: Local weak convergence: theory
Lecture 3: Local weak convergence of random graphs
Lecture 4: The giant in random graphs is almost local
Lecture 5: Small-world structure of random graphs

This lecture series is based on joint work with, amongst others: Gerard Hooghiemstra, Shankar Bhamidi, Júlia Komjáthy, Piet Van Mieghem, Henri van den Esker, and Dmitri Znamenski.

2.2 Invited Speakers

Luca Dall'Asta
Inverse problems in epidemic dynamics
Politecnico di Torino, Italy

Advanced mean-field methods, originally developed in the statistical physics of disordered systems, have been recently applied to tackle (high-dimensional) inference problems. Epidemic dynamics in social networks give rise to a variety of interesting inference problems, which are computationally difficult to deal with even when a large set of data is available (e.g. the patient-zero problem and more generally the reconstruction of causal relations from point-like/snapshot observations). I will formulate these problems in a Bayesian framework, using probabilistic graphical models and applying mean-field methods (such as Belief Propagation) in order to estimate posterior marginal probabilities and parameters. I will focus on a recent application of these techniques to the spread of cattle diseases in the livestock trading network. Finally, I will briefly discuss the application to this class of inference problems of popular methods from machine learning (such as autoregressive neural networks).

Maria Deijfen
Competing growth on lattices and graphs
Stockholm University, Sweden

Competing first passage percolation describes the growth of two competing infections on an underlying graph structure. It was first studied on the Z^d-lattice. The main question is if the infection types can grow to occupy infinite parts of the lattice simultaneously, the conjecture being that the answer is yes if and only if the infections grow with the same intensity. Recently, the model has also been analyzed on more heterogeneous graph structures, where the degrees of the vertices can have an arbitrary distribution. In this case, it turns out that also the degree distribution plays a role in determining the outcome of the competition. I will give a survey of existing results, both on Z^d and on heterogeneous graphs, and describe open problems.

James Gleeson
Branching processes as models of cascade dynamics on networks
University of Limerick, Ireland

Network models may be applied to describe many complex systems, and in the era of online social networks the study of dynamics on networks is an important branch of computational social science. Cascade dynamics can occur when the state of a node is affected by the states of its neighbours in the network, for example when a Twitter user is inspired to retweet a message that she received from a user she follows, with one event (the retweet) potentially causing further events (retweets by followers of followers) in a chain reaction. In this talk I will review some mathematical models that can help us understand how social contagion (the spread of cultural fads and the viral diffusion of information) depends upon the structure of the social network and on the dynamics of human behaviour. Although the models are simple enough to allow for mathematical analysis, I will show examples where they can also provide good matches to empirical observations of cascades on social networks.

Marc Lelarge
A statistical physics approach to learning for complex networks
INRIA Paris, France

In this talk, we show how ideas from physics can be used to better understand some of the machine learning methods and inspire new ones. Using the examples of community detection and low-rank matrix estimation (PCA, sparse PCA or submatrix localization), we propose a probabilistic model for these high-dimensional inference problems and prove information theoretic limits in the high noise regime. Building on the concepts adapted from statistical physics, we design new algorithms and discuss the impossible/hard/easy phase transitions.

Nicos Starreveld
Large deviations and the Erdős-Rényi random graph
University of Amsterdam, Netherlands

In this talk I will give an overview of the theory of large deviations in the Erdös-Rényi random graph. I will start with the dense case and present some early results concerning the tail probability of subgraph counts. Afterwards I will discuss the large deviations principle proven by Chatterjee and Varadhan, I will also highlight the main ideas behind the proof of this beautiful result. Using this result I will discuss the most likely structure of an Erdös-Rényi random graph given some constraint. If time allows I want to present some recent results concerning sparse random graphs. I will close the talk with some open problems and questions that I have encountered during my research.

Tiziano Squartini
Maximum-entropy models for networks
IMT Lucca, Italy

Entropy-maximization represents the unifying concept underlying the definition of a number of methods which are now part of the discipline known as "network theory". This talk aims at illustrating the methodological aspects of the aforementioned approach, with particular emphasis on the definition of null models. After having described the recipe to define constrained maximum-entropy network ensembles in its full generality, an overview of its applications will be provided. In particular, we will focus on pattern detection and network reconstruction techniques. While the former ones will be employed to reveal early-warning signals of the 2007–2008 worldwide crisis on the Dutch Interbank Network, the latter ones will be used to infer the unaccessible details of a couple of real-world systems (in particular, the World Trade Web and the Electronic Italian Interbank Money Market). As a conclusion, different ways of enforcing constraints (i.e., either exactly or on average) will! be proven not to lead to equivalent ensembles, as measured by the entropy functional. In physical terms, the latter statement can be rephrased by saying that the microcanonical and canonical recipes are, in several cases of interest, not equivalent. The latter remark implies that the approach used to analyse networks indeed makes a difference and should not be underestimated whenever approaching the study of real-world systems.

2.3 Further Speakers

Boshra Alarfaj
Statistical Methods for Graphical Networks
University of Leeds, UK

To understand the structure of a network, many useful measures can be computed to detect certain properties of the network topology. This talk will discuss some of the existing methods, such as degree centrality, community detection, hierarchical clusters, transitivity, and adjusted Rand index, which are applied to a real dataset (Ego-Facebook). We compare the results with different classes of random graph models such as Erdös-Rényi and Watts-Strogatz. Our aim is to address and discuss some open questions about comparing community structure and selecting effective methods to expose network structure.

Luisa Andreis
A large-deviations approach to the phase transition in inhomogeneous random graphs: part II
WIAS Berlin, Germany

In this talk, we focus on the form of the large deviations rate function presented in part I (see talk by Heide Langhammer). The analysis of the minimizers of this function allows to recover the criterion for the existence of the phase transition in inhomogeneous sparse random graphs given by Bolloás, Janson, Riordan (2007). Moreover, it gives the explicit optimal configuration of the graph, not only in terms of macroscopic connected components but also including exact statistics of microscopic ones. This is a joint work with W. König , H. Langhammer and R. Patterson.

Soukaina El Masmari
Fluid equations and Skorokhod problem
University Hassan II Casablanca, Morocco

In the present work, stochastic differential equations with reflecting boundaries associated to a Markov process are used to model a storage system of file servers where files can be duplicated, copies of files can be lost and new files can be added to the system.
A three-dimensional version of Skorokhod problem in a convex domain is used to investigate the fluid equations associated to such stochastic differential equations and show existence and uniqueness of the solution of this Skorokhod's problem, in

addition to some results of simulations of the problem.

References:
[1] Mathieu Feuillet and Philippe Robert, A scaling analysis of a transient stochastic network, Advances in Applied Probability 46 (2014), no. 2, 516–535.
[2] Philippe Robert, Stochastic networks and queues, Stochastic Modeling and Applied Probability Series, vol. 52, Springer, New-York, June 2003.
[3] H. Tanaka, Stochastic differential equations with reflecting boundary condition in convex regions, Hiroshima Math. J. 9 (1979), pp. 163–177.

John Fernley
Voter Models on Subcritical Scale-Free Networks
University of Bath, UK

We look to analyse the speed of consensus for the voter model on a scale-free network as a toy model to understand macroscopic behaviour of interacting agents spreading competing “opinions” on heterogeneous graphs.
The quenched orders of the expected consensus time are nonrigorously established in [Sood, Antal, Redner ’08], except that their mean-field approach cannot capture the subcritical regime. So we determine and prove rigorously these polynomial orders on subcritical scale-free networks for voter models with both the typical imitative interaction and a discursive interaction which is less studied but no less natural. In particular, in the case of the most typical voter model parameters this leads to a surprising exponent coming from the component of slowest mixing for the simple random walk.

Mohamed Ali Hammami
New stability criteria for stochastic evolution equations
University of Sfax, Tunisia

This work studies the problem of stability for some classes of stochastic evolution equations. We consider the problem of asymptotic behavior of solutions. Some new sufficient conditions are obtained to ensure the quasi sure exponential stability of stochastic differential equations perturbed by G-Brownian motion with respect to a part of the variables.

References
[1] Caraballo Tomas, Hammami Mohamed Ali and Mchiri Lassad, Practical asymptotic stability of nonlinear stochastic evolution equations, Stochastic Analysis and Applications, 32, no. 1, (2014) 77–87.
[2] Caraballo Tomas, Hammami Mohamed Ali and Mchiri Lassad, Practical exponential stability of impulsive stochastic functional differential equations, Systems

and Control Letters 109 (2017) 43–48.
[3] Tomas Caraballo, Faten Ezzine and Mohamed Ali Hammami, Stability with respect to a part of the variables of stochastic differential equations driven by G-Brownian motion, submitted to Acta Appl. Math. (2019).

Simon Holbach
Feed-forward chains as filter amplifiers for randomly perturbed periodic forcing
Bielefeld University, Germany

Consider a chain of coupled identical systems whose internal dynamics are near a point of Hopf bifurcation. In certain situations, if a suitable periodic forcing signal with a frequency close to the respective Hopf frequency is added to the first node, each successive node will imitate the signal, but with a growing amplitude. In other words, such chains can act as a filter amplifier for incoming signals, and some authors have suggested their use as a model for the human auditory system. We study the corresponding high-dimensional degenerate SDE that arises from adding noise to the forcing. The talk is based on ongoing joint work with Barbara Gentz.

Tejas Iyer
Random Trees with Independent Fitnesses
University of Birmingham, UK

We study a general model of recursive trees where vertices are equipped with independent fitnesses. In this discrete time model, ℓ vertices arrive at each time step and attach to an existing vertex with probability proportional to a positive function of their fitness and degree. We derive general formulas for the limiting degree distributions and the height of the tree, and discuss applications of this model to the study of randomly evolving simplicial complexes.

Heide Langhammer
A large-deviations approach to the phase transition in inhomogeneous random graphs: part I
WIAS Berlin, Germany

In this talk, we study inhomogeneous sparse random graphs introduced by Bolloás, Janson, Riordan (2007) from a large deviation point of view. Inhomogeneity in this framework is represented by the fact that vertices in the random graph are characterized by a type and edges between different vertices occur randomly, independently one from the other, depending on the type of the two vertices at its end and the sparse regime is the one in which the average degree is O(1). Our aim is to prove a large deviation principle for the statistics of connected components. This is a joint work with L. Andreis, W. König and R. Patterson.

Bas Lodewijks
The preferential attachment model with additive fitness
University of Bath, UK

We investigate several evolutionary random graph models that are based on a preferential attachment structure, but which include an additive fitness in the connection rule. In this way we add a heterogeneity to the random graph model other than the age of the vertices.
We shall see that, for particular choices of the fitness distribution, the degree distribution and the maximum degree of the graph behave differently than in the well-studied classical preferential attachment models. More precisely, for the maximum degree, in the weak disorder regime we see that the graph attains its maximum degree at a fixed vertex for all but finitely many steps, whereas in the strong disorder regime the maximum degree is never fixed and the maximum degree grows at a different order.

Peter Mühlbacher
Critical Parameters for Loop and Bernoulli Percolation
University of Warwick, UK

We consider a class of random loop models (including the random interchange process) that are parametrised by a time parameter $\beta \geq 0$. At $\beta = 0$ we start with loops of length 1 and as β crosses a critical value β_c, infinite loops start to occur almost surely. These random loop models admit a natural comparison to bond percolation on the same graph to obtain a lower bound on β_c. For those graphs of diverging vertex degree where β_c and the critical parameter for percolation have been calculated explicitly, that inequality has been found to be an equality. In contrast, we show here that for graphs of bounded degree the inequality is strict, i.e. we show existence of an interval of values of β where there are no infinite loops, but infinite percolation clusters almost surely.

Stephanie Nargang

The hyperbolic geometry of financial networks

TU Dresden, Germany

The popularity-vs-similarity model based on hyperbolic geometry (cf. [1]) has been a breakthrough in the research of network structure. It has been the first model resolving the conflicting paradigms of preferential attachment (attraction to popular nodes) and community effects (attraction to similar nodes) in networks and has been successfully used to explain the structure of informational, social and biological networks.
Just as the geometric structure of a social network determines the diffusion of news, rumors or infective diseases between individuals, the geometric structure of a financial network influences the diffusion of financial distress between financial institutions. Indeed, the lack of understanding for risks originating from the systemic interaction of financial institutions has been identified as a major contributing factor to the global financial crisis of 2008. While many recent studies have analysed the mechanisms of financial contagion in theoretical or simulation-based settings, less attention has been payed to structural characteristics of real financial networks and on the interaction between this structure and contagion processes. In particular, it has remained an open question whether the paradigm of hyperbolic structure applies to financial and economic networks and what such a structure implies for financial contagion processes.
In this talk we consider financial networks inferred from bank balance sheet data. We first show that these networks can efficiently be embedded into lowdimensional hyperbolic space with considerably smaller distortion than into Euclidean space, suggesting that the paradigm of latent hyperbolic geometry also applies to financial networks. Furthermore, we follow the approach in [1] and provide a structural decomposition of the embedding coordinates into popularity and similarity dimension and demonstrate that these dimensions align with systemic importance and membership in regional banking clusters respectively. We present rigorous computations to prove that the popularity dimension of a given bank aligns with its systemic importance and that its similarity dimension is associated with sub-sectors of the banking system. Finally, we exploit the longitudinal structure of the data to track changes in these dimensions over time, i.e., to track systemic importance of individual banks.

[1] F. Papadopoulos, M. Kitsak, M. Serrano, M. Boguná, D. Krioukov (2012).
Popularity versus similarity in growing networks. Nature

Ruheyan Nuermaimaiti
Citation networks and integer partitions
University of Leeds, UK

Citation networks is a classical topic in scientometrics dating back to A. Lotka and D. Price. One important consequence of this theory is that the number of papers T and the corresponding number of citations N are asymptotically proportional to each other. A different approach was recently coined by A. Yong (2014) by interpreting an author's citation profile as a Young diagram of the corresponding integer partition (decomposing N into citations per paper). Assuming for simplicity that such diagrams are equally likely (for a given N), and using the so-called limit shape (as $N \to \infty$), one can characterise typical asymptotic properties of citation diagrams, such as the h-index. However, this theory predicts that T grows roughly as $\sqrt{N}$, which is in sharp contrast with the network approach.
In my talk, I will describe work in progress on testing these two theories statistically using real citation data collected from Google Scholar. My first results indicate that the partitions approach, even if based on a disputable assumption of uniform distribution, produces a surprisingly good fit to the data.

Dominik Schmid
Mixing times for the simple exclusion process with open boundaries
TU München, Germany

The exclusion process is one of the best-studied examples of an interacting particle system. In this talk, we focus on the exclusion process on the segment when particles are allowed to enter and exit at the ends of the segment. Our goal is to study its total variation mixing time, which is the standard way of measuring the speed of convergence to equilibrium. We give an overview over some recent results on the mixing time of the exclusion process with open boundaries.
This talk is based on joint work with Nina Gantert and Evita Nestoridi.

Sam Thomas
Random Cayley Graphs: A Conjecture of Aldous and Diaconis
University of Cambridge, UK

I shall introduce mixing times, and then speak briefly about a conjecture of Aldous and Diaconis regarding cutoff for random walks on random Cayley graphs.

András Tóbiás
Degree bounds and percolation in SINR graphs based on Cox point processes
TU Berlin, Germany

Signal-to-interference plus noise (SINR) graphs are an infinite range dependent variant of continuum percolation, modelling connections between users in a telecommunication network. One interesting property of these graphs is that they have bounded degrees: if the interference cancellation factor is $\gamma > 0$ and the SINR threshold is $\tau > 0$, then all vertices have degrees less than $1 + 1/(\tau\gamma)$. This was proven by Dousse et al. in 2003. It immediately implies that the graph contains no infinite connected component in the case $\gamma \geq 1/\tau$ when the degree bound is 1. In this short talk I will present the following result: in case the SINR graph is based on a stationary Cox point process, then there is even no percolation for $\gamma \geq 1/(2\tau)$, i.e., when degrees are bounded by two. This holds in any dimension and also if the signal powers are random. The subject of the talk is joint work with B. Jahnel.

Jan van Waaij
Non-asymptotic uncertainty quantification in the stochastic block model with an unknown number of classes.
University of Padova, Italy

We study the frequentist performance of Bayesian statistical inference for the stochastic block model, with an unknown number of classes. We equip the space of labelings with a prior on the number of classes and conditionally on the number of classes a prior on the labels. The number of classes may grow to infinity as a a function (depending on the sparsity) of the number of nodes.
We derive sharp non-asymptotic posterior contraction rates of the form $(P_{\theta_0}\Pi_n(B_n \mid X^n) \leq \epsilon_n)$, where, for all $(n), (B_n)$ is an (explicitly known) ball around the true parameter, (X^n) is the observed graph and (ϵ_n) is an explicit value.
This result enables us to construct confidence sets via credible sets. When graphs are not too sparse, credible tests are shown to be confidence sets. In the very sparse Kesten-Stigum phase enlarged credible sets are shown to be confidence sets. In both cases the exact confidence level is given in terms of the credible level.
Testing between the number of classes is considered with the help of posterior odds, which is shown to be consistent and explicit upper bounds for errors of the first and second type as well as an explicit lower bound on the power of the test is given.

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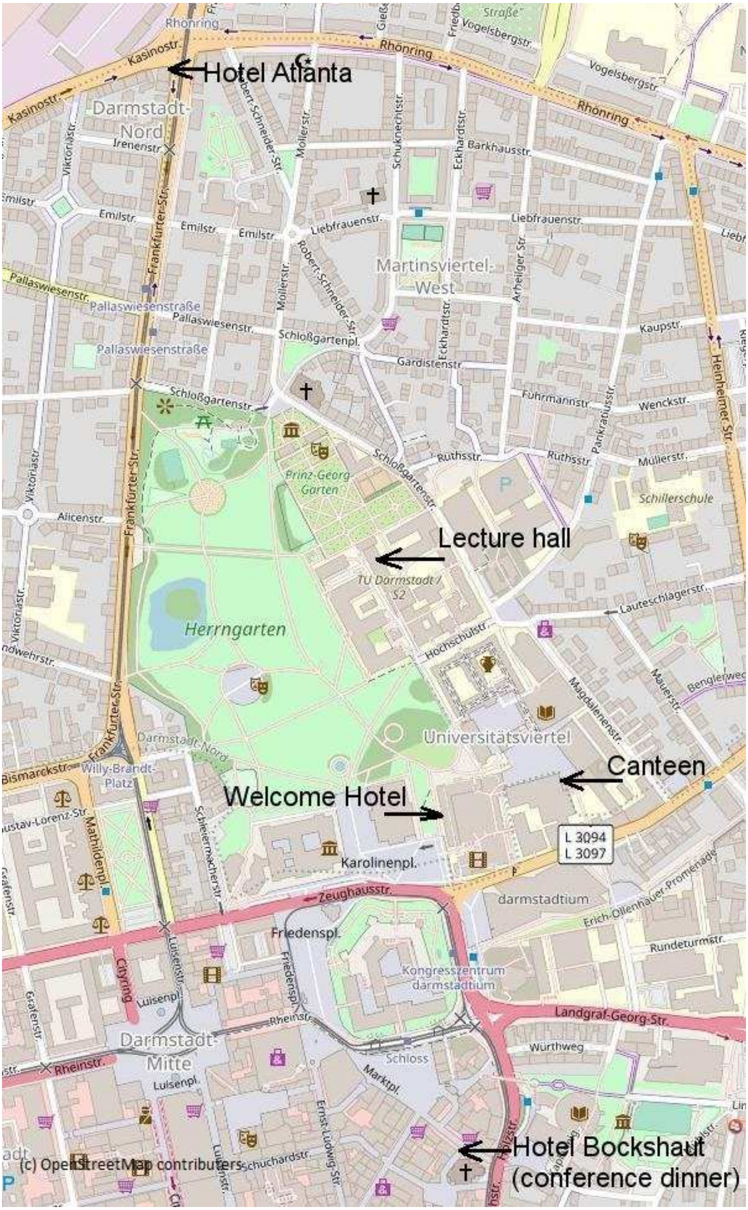

Hotel Atlanta
Lecture hall
Canteen
Welcome Hotel
Hotel Bockshaut
(conference dinner)
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Kasinostr.
Darmstadt-Nord
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Frankfurter Str.
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Emilstr.
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Barkhausstr.
Schuknechtstr.
Eckhardtstr.
Vogelsbergstr.
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Arheilger Str.
Robert-Schneider-Str.
Pallaswiesenstr.
Pallaswiesenstraße
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