NETWORKS

University of Amsterdam
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Programme of the 11th NETWORKS Training week

Monday 19 April

9.30 – 10.30	Minicourse lecture 1: Approximations in Stochastic Integer Programming, by Leen Stougie and Ward Romeijnders
10:30 – 11.00	Break
11.00 – 11.30	Introduction new PhD students • Roshan Mahesh (UvA) • Gianluca Kosmella (TU/e) • Tim Engels (TU/e)
11.30 – 11.55	Introduction talk Laura Sanita (TU/e)
11.55 – 12.10	Short break
12.10 – 13.00	Research presentations, Session 1 (Games and Neural networks) : • Ben Meylahn (UvA) • Albert Senen Cerda (TU/e)
13.00 - 13.30	Open problem session • Viresh Patel (UvA) • Rajat Hazra (UL)

Tuesday 20 April

9.30 – 10.30	Minicourse lecture 2: Approximations in Stochastic Integer Programming, by Leen Stougie and Ward Romeijnders
10:30 – 11.00	Break
11.00 – 11.50	Research presentations, Session 2 (Queueing and Scheduling): • Martin Zubeldia (UvA and TU/e) • Diego Goldsztajn (TU/e)
11.50 – 12.00	Short break
12.00 – 12.50	Research presentations, Session 3 (Queueing and Wireless Networks): • Lucas van Kreveld (UvA) • Youri Raaijmakers (TU/e)

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15.00 – 17.00	Social Event

Thursday 22 April

9.30 – 10.30 Minicourse lecture 3: Approximations in Stochastic Integer Programming, by Leen Stougie and Ward Romeijnders

10:30 – 11.00 Break

11.00 – 11.50 Research presentations, Session 4 (Graph algorithms):

- Bart Jansen (TU/e)
- Henk Alkema (TU/e)

11.50 – 12.00 Short break

12.00 – 12.50 Research presentations, Session 4 (Combinatorial optimization):

- Roel Lambers (TU/e)
- Celine Swennenhuis (TU/e)

Friday 23 April

9.30 – 10.30 Minicourse lecture 4: Approximations in Stochastic Integer Programming, by Leen Stougie and Ward Romeijnders

10:30 – 11.00 Break

11.00 – 11.50 Research presentations, Session 5 (Random graphs & processes):

- Twan Koperberg (UL)
- Joost Jorritsma (TU/e)

11.50 – 12.00 Short break

12.00 – 12.50 Research presentations, Session 5, continued

- Oliver Nagy (UL)
- Fabian Stroh (UvA)

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Abstracts

Roshan Mahesh - Appointment Scheduling
In my PhD project I'm looking at ways to improve the predicted delivery time slots provided by PostNL. In particular, the goal is to make these arrival intervals smaller, more reliable and adaptive.

Gianluca Kosmella - Optical Neural Networks: challenges and prospects
A different approach to microelectronics offered by photonic platforms is promising in many ways. Exploiting the special properties of optics in artificial neural networks especially suggests benefits like parallel processing and decoupling energy consumption from size.
Challenges lie in scalability and accumulation of noise and crosstalk, such that there is an expected trade-off between the depth and height of a network versus the theoretical qualities, which, among other things, will be investigated during this project.

Tim Engels - Transportation and traffic networks
Tim Engels received both BSc and MSc from the TU/e, both of which in the field of Mathematics. Additionally Tim has received an additional Masters Degree in Econometrics at Tilburg University. During both these studies Tim has focused on applying probability theory to a wide range of problems.

From April 2021 onwards Tim will be a PhD student at the TU/e, focusing on order collection systems and will be supervised by Jacques Resing.

Laura Sanita – to be announced

Ben Meylahn - The evolutionary snowdrift game on a cycle graph
In this presentation, we analyse the temporal dynamics of the evolutionary 2-person, 2-player snowdrift game in which players are arranged along a cycle of arbitrary length. In this game, each player has the option of adopting one of two strategies, namely cooperation or defection, during each game round. We compute the probability of retaining persistent cooperation over time from a random initial assignment of strategies to players. We adopt an analytic approach throughout as opposed to simulation.

Albert Senen Cerda - Asymptotic convergence rate of Dropout on shallow linear neural networks
We analyze the convergence rate of gradient flows on objective functions induced by Dropout and Dropconnect, when applying them to shallow linear Neural Networks (NNs)—which can also be viewed as doing matrix factorization using a particular regularizer. Dropout algorithms such as these are thus regularization techniques that use {0, 1}-valued random variables to filter weights during training in order to avoid coadaptation of features. By leveraging a recent result on nonconvex optimization and conducting a careful analysis of the set of minimizers as well as the Hessian of the loss function, we are able to obtain (i) a local convergence proof of the gradient flow and (ii) a bound on the convergence rate that depends on the data, the dropout probability, and the width of the NN. Finally, we compare

this theoretical bound to numerical simulations, which are in qualitative agreement with the convergence bound and match it when starting sufficiently close to a minimizer.

Martín Zubeldía - Learning traffic correlations in multi-class queueing systems by sampling workloads
We consider a service system consisting of parallel single server queues of infinite capacity. Work of different classes arrives as correlated Gaussian processes with known drifts but unknown covariances, and it is deterministically routed to the different queues according to some routing matrix. In this setting we show that, under some conditions, the covariance matrix of the arrival processes can be directly recovered from the large deviations behavior of the queue lengths. Also, we show that in some cases this covariance matrix cannot be directly recovered this way, as there is an inherent loss of information produced by the dynamics of the queues. Finally, we show how this can be used to quickly learn an optimal routing matrix with respect to some utility function.

Diego Goldsztajn - Self-Learning Threshold-Based Load Balancing In this talk we consider a service system where incoming tasks are instantaneously routed to one out of many parallel and identical server pools. The execution time of tasks does not depend on the number of concurrent tasks at the same server pool, but the user-perceived performance may degrade as the number of tasks sharing a given server pool increases. To maintain the maximum number of tasks per server pool low, we propose a threshold-based load balancing mechanism; this policy only involves low complexity at the dispatcher and is optimal on the fluid and diffusion scale. In order to achieve optimality, it is important to learn the arrival rate of tasks. For that purpose we design a control rule for updating the threshold, based on online measurements. We provide conditions which guarantee that the threshold settles at an optimal value, as well as estimates for the time until this happens.

Lucas van Kreveld - When does the Gittins policy have optimal response time tail?
It is known that the Gittins scheduling policy minimizes the mean response time of jobs in the M/G/1 setting. In this talk we adress the response time tail of Gittins, depending on the job size distribution.

Youri Raaijmakers - Reinforcement learning for Admission Control in 5G Wireless Networks
The key challenge in admission control in wireless networks is to strike an optimal trade-off between the blocking probability for new requests while minimizing the dropping probability of ongoing requests. In this talk, we consider two approaches for solving the admission control problem: i) the typically adopted threshold policy and ii) our proposed policy relying on reinforcement learning with neural networks. Extensive simulation experiments are conducted to analyze the performance of both policies. The results show that the reinforcement learning policy outperforms the threshold-based policies in the scenario with heterogeneous time-varying arrival rates and multiple user equipment types, proving its applicability in realistic wireless network scenarios.

Bart Jansen - Vertex Deletion Parameterized by Elimination Distance and Even Less
We study the parameterized complexity of various classic vertex deletion problems such as Odd cycle transversal, Vertex planarization, and Chordal vertex deletion under hybrid parameterizations. Existing FPT algorithms for these problems either focus on the parameterization by solution size, detecting solutions of size k in time f(k) \cdot n^{O(1)}, or width parameterizations, finding arbitrarily large

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optimal solutions in time f(w) \cdot n^{O(1)} for some width measure w like treewidth. We unify these lines of research by presenting FPT algorithms for parameterizations that can simultaneously be arbitrarily much smaller than the solution size and the treewidth.
The first class of parameterizations is based on the notion of elimination distance of the input graph to the target graph class H, which intuitively measures the number of rounds needed to obtain a graph in H by removing one vertex from each connected component in each round. The second class of parameterizations consists of a relaxation of the notion of treewidth, allowing arbitrarily large bags that induce subgraphs belonging to the target class of the deletion problem as long as these subgraphs have small neighborhoods. Both kinds of parameterizations have been introduced recently and have already spawned several independent results.
Our contribution is twofold. First, we present a framework for computing approximately optimal decompositions related to these graph measures. Namely, if the cost of an optimal decomposition is k, we show how to find a decomposition of cost k^{O(1)} in time f(k) \cdot n^{O(1)}. This is applicable to any class H for which we can solve the so-called separation problem. Secondly, we exploit the constructed decompositions for solving vertex-deletion problems by extending ideas from algorithms using iterative compression and the finite state property. For the three mentioned vertex-deletion problems, and all problems which can be formulated as hitting a finite set of connected forbidden (a) minors or (b) (induced) subgraphs, we obtain FPT algorithms with respect to both studied parameterizations. For example, we present an algorithm running in time n^{O(1)} + 2^{k^{O(1)}} \cdot (n+m) and polynomial space for Odd cycle transversal parameterized by the elimination distance k to the class of bipartite graphs.

Henk Alkema - Rectilinear Steiner Trees in Narrow Strips
A rectilinear Steiner tree for a set P of points in R2 is a tree that connects the points in P using horizontal and vertical line segments. The goal of the MINIMUM RECTILINEAR STEINER TREE problem is to find a rectilinear Steiner tree with minimal total length. We investigate how the complexity of MINIMUM RECTILINEAR STEINER TREE for point sets P inside a strip (-∞,+∞) x [0, δ] depends on the strip width δ. We obtain two main results.

- We present an algorithm with running time nO(√d) for sparse point sets, that is, point sets where each 1xδ rectangle inside the strip contains O(1) points.
- For random point sets, where the points are chosen randomly inside a rectangle of height δ and expected width n, we present an algorithm that is fixed-parameter tractable with respect to δ and linear in n. It has an expected running time of 2O(δ √d) n.

Roel Lambers - Volleyball Nations league – fair travel times in the social golfer problem
The Volleyball Nations League is the elite annual international competition within volleyball, with the sixteen best nations per gender contesting the trophy in a tournament that spans over 6 weeks. The first five weeks contain a single round robin tournament, where matches are played in different venues across the globe. As a result of this setup, there is a large discrepancy between the travel burdens of meeting teams, which is a disadvantage for the teams that have to travel a lot. We analyze this problem, and find that it is related to the well-known Social Golfer Problem. We propose a

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decomposition approach for the resulting optimization problem, leading to the so-called Venue Assignment Problem. Using integer programming methods, we find, for real-life instances, the fairest schedules with respect to the difference in travel distance.

Celine Swennenhuis - Parameterized Complexity of Connected Flow and Many Visits TSP
In the Connected Flow problem we are given a directed graph G with distances and capacities on the edges, and a set D of vertices such that each vertex in D has a fixed demand. We then ask for a minimal distance connected flow on the edges that satisfies the demand for each vertex in D, i.e. we look for a flow conserving function f: E -> N, such that all edges with strictly positive flow are connected and the total flow coming into v in D is equal to its demand.

This problem is a generalization of (Many Visits) TSP, as well as a natural extension of the Minimum Cost Flow problem. As the problem is clearly NP-hard, we study the parameterized complexity of this problem for the following three parameters:
1) the size of the set D,
2) the treewidth of G and
3) the size of a vertex cover of G.

One of the main results is a polynomial kernel for Many Visits TSP in the size of a vertex cover.

Twan Koperberg - Couplings and Matchings
Some mathematical theorems represent ideas that are discovered again and again in different forms. One such theorem is Halls's marriage theorem, which provides a necessary and sufficient condition for the existence of a perfect matching in bipartite graphs. This theorem is equivalent to several other theorems in combinatorics and optimisation theory, in the sense that these results can easily be derived from each other. During this presentation we will see that this equivalence extends to Strassen's theorem, a result on couplings of probability measures. For this purpose we will introduce a lemma that can be used to deduce both Hall's theorem and a simplified version of Strassen's theorem.

Joost Jorritsma - Distance evolutions in growing preferential attachment graphs
We study the evolution of the graph distance and weighted distance between two fixed vertices in dynamically growing random graph models. More precisely, we consider preferential attachment models with power-law exponent $\tau\in(2,3)$, sample two vertices ut,vt uniformly at random when the graph has t vertices, and study the evolution of the graph distance between these two fixed vertices as the surrounding graph grows. This yields a discrete-time stochastic process in $t'\geq t$, called the distance evolution. We show that there is a tight strip around the function $4\log\log(t)-\log(1\vee\log(t'/t))|\log(\tau-2)|\vee 4$ that the distance evolution never leaves with high probability as t tends to infinity. We extend our results to weighted distances, where every edge is equipped with an i.i.d. copy of a non-negative random variable L.

Oliver Nagy - Linking the mixing times of random walks on static and dynamic random graphs
Abstract t.b.a.

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