Symposium on Hiking in the Scheduling Landscape

29 November, room A1.23, Tongersestraat 53, Maastricht

There is no registration fee, but registration is compulsory for organizational purposes. To register, please follow this link. Please register before Monday, November 21. There is no need to bring the ticket with you.

We thank Maastricht University School of Business and Economics and the Graduate School of Business and Economics for their financial support.

11:00 Lars Rohwedder (Maastricht University)

Better Trees for Santa Claus

11:45 Marjan den Akker (Universiteit Utrecht)

Scheduling electric vehicles by Simulated Annealing with recombination through ILP

12:30 Lunch (free for all participants)

13:30 Tim Oosterwijk (Vrije Universiteit Amsterdam)

The Secretary Problem with Independent Sampling

14:15 Nicole Megow (Universität Bremen)

Online Routing and Network Design with Predictions

16:00 Public Defence by Moritz Buchem of his PhD thesis " Hiking in the Scheduling Landscape: Exact and Approximation Algorithms for Parallel Machines” in the aula of Maastricht University, Minderbroedersberg 4-6, Maastricht

Abstracts

Lars Rohwedder: Better Trees for Santa Claus

We revisit the problem max-min degree arborescence, which was introduced by Bateni et al. [STOC'09] as a central special case of the general Santa Claus problem, whose approximability remains a notoriously open question in approximation algorithms. In the problem we are given a directed graph with sources and sinks and our goal is to find vertex disjoint arborescences rooted in the sources such that at each non-sink vertex of an arborescence the out-degree is at least k, where k is to be maximized.

We present a poly(loglog n)-approximation in quasi-polynomial time, an exponential improvement to the state-of-the-art. To the best of our knowledge, this is the first example of breaking the logarithmic barrier for a special case of the Santa Claus problem, where the configuration LP cannot be utilized.

This is joint work with Etienne Bamas.

Marjan den Akker: Scheduling electric vehicles by Simulated Annealing with recombination through ILP

We consider the Electric Vehicle Scheduling Problem (e-VSP): a set of trips corresponding to a given timetable have to be driven by a set of electric buses. This problem, like many other planning problems, boils down to assigning to each bus a subset of the trips with the obvious side-constraint that the selected subset can be feasibly driven by this single bus; such a feasible subset is called a (vehicle) task then. If we know all possible tasks, then we can select the best set of tasks by solving an ILP. This idea has inspired many researchers to the heuristic of finding a decent subset of all tasks using the technique of Column Generation and then solve the ILP. For the e-VSP this approach leads to reasonable solutions, but there is still room for improvement. Instead of using Column Generation, we present a solution approach by applying Simulated Annealing to find the subset of tasks that we use as input for the ILP. For the e-VSP this leads to far better solutions. Moreover, our approach is generally applicable and has as a clear advantage that we do not have to solve the pricing problem anymore. To illustrate this, we show how to solve the problem of routing cargo bikes by a similar method. For this problem, our hybrid approach outperforms an existing local search algorithm from literature.

This is joint work with Wouter ten Bosch, Philip de Bruin, Sam Hesselmans, Han Hoogeveen, and Marcel van Kooten Niekerk.

Tim Oosterwijk: The Secretary Problem with Independent Sampling

The secretary problem is probably the most well-studied optimal stopping problem with many applications in economics and management. In the secretary problem, a decision-maker faces an unknown sequence of values, revealed one after the other, and has to make irrevocable take-it-or-leave-it decisions. Her goal is to select the maximum value in the sequence. While in the classic secretary problem, the values of upcoming elements are entirely unknown, in many realistic situations, the decision-maker still has access to some information, for example, in the form of past data.

In this talk we take a sampling approach to the problem and assume that before starting the sequence, each element is independently sampled with probability p. This leads to what we call the random order and adversarial order secretary problems with p-sampling. In the former, the sequence is presented in random order, while in the latter, the order is adversarial.

Our main result is to obtain the best possible algorithms for both problems and all values of p. As p grows to 1, the obtained guarantees converge to the optimal guarantees in the full information case, that is, when the values are i.i.d. random variables from a known distribution. Notably, we establish that the best possible algorithm in the adversarial order setting is a simple fixed threshold algorithm. In the random order setting, we characterize the best possible algorithm by a sequence of thresholds, dictating at which point in time we should start accepting a value. Surprisingly, this sequence is independent of p.

We complement our theoretical results with practical insights obtained from numerical experiments on real life data obtained from Goldstein et al. (Management Science 2019), who conducted a large-scale behavioral experiment in which people repeatedly played the secretary problem. Our results help explain some behavioral issues they raised and indicate that people play in line with a strategy similar to our optimal algorithms from the first game onwards, albeit slightly suboptimally.

This is joint work with José Correa, Andrés Cristi, Laurent Feuilloley and Alexandros Tsigonias-Dimitriadis.

Nicole Megow: Online Routing and Network Design with Predictions

Online optimization refers to solving problems where an initially unknown input is revealed incrementally, and irrevocable decisions must be made not knowing future requests. The assumption of not having any prior knowledge about future requests seems overly pessimistic. Given the success of machine-learning methods and data-driven applications, one may expect to have access to predictions about future requests.

However, simply trusting them might lead to very poor solutions as these predictions come with no quality guarantee. In this talk we present recent developments in the young line of research that integrates such error-prone predictions into algorithm design to break through worst case barriers. We discuss algorithmic challenges with a focus on online routing and network design and present algorithms with performance guarantees depending on a novel error metric.

This is joint work with Giulia Bernardini, Alexander Lindermayr, Alberto Marchetti-Spaccamela, Leen Stougie, and Michelle Sweering; NeurIPS 2022.