

**Program of the
First Aachen – Maastricht Seminar on Algorithms and Games
Faculty of Economics and Business Administration
Maastricht University
11.04.2007, Room A.1.22**

14:00 – 14:40

Sascha Wolf, Universiteit Maastricht

Weak Monotonicity and Bayesian Nash Implementation

An allocation rule is called Bayes–Nash incentive compatible, if there exists a payment rule, such that truthful reports of agents' types form a Bayes–Nash equilibrium in the direct revelation mechanism consisting of the allocation rule and the payment rule. This paper provides a characterization of Bayes–Nash incentive compatible allocation rules in social choice settings where agents have multi-dimensional types, quasi-linear utility functions and interdependent valuations. The characterization is derived by constructing complete directed graphs on agents' type spaces with cost of manipulation as lengths of edges. Weak monotonicity of the allocation rule corresponds to the condition that all 2-cycles in these graphs have nonnegative length. For the case that type spaces are convex and the valuation for each outcome is a linear function in the agent's type, we show that weak monotonicity of the allocation rule together with an integrability condition is a necessary and sufficient condition for Bayes–Nash incentive compatibility.

This is joint work with Rudolf Müller and Andres Perea

14:40 – 14:50 Coffee

14:50 – 15:30

Heiko Rögling, RWTH Aachen

Uncoordinated Stable Matchings

In the stable marriage problem, we are given a set of women and a set of men. Each woman has a ranking on the set of men that represents her preferences, and vice versa. The goal is to find a matching between women and men that is stable in the sense that no woman and man prefer each other to their current partners. It is well known that a stable matching always exists and can be computed in polynomial time.

Motivated by the fact that in many scenarios that can be modeled by the stable marriage problem no central authority exists, we take a game theoretic view on this problem. We introduce and analyze several uncoordinated processes in which a given matching is altered consecutively by resolving blocking pairs. A blocking pair is a pair of a woman and a man who prefer each other to their current partners, and resolving the blocking pair means that the corresponding woman and man marry and leave their current partners unmarried.

Such a sequence of consecutive alterations can cycle even if women marry only their best available partners. On the other hand, for any matching there exists a short sequence of blocking pairs whose consecutive resolution yields a stable matching. This motivates the study of the expected convergence time. We analyze random processes in which at each time a random blocking pair is resolved and present exponential lower bounds on the expected number of steps until a stable matching is reached.

Finally, we consider instances in which the preference lists of men and women are correlated. In these instances each possible marriage has a certain weight and all players want to maximize the weight of their marriage. For these instances we prove a polynomial upper bound on the expected convergence time.

This is joint work with Heiner Ackermann, Paul Goldberg, Vahab Mirrokni, and Berthold Vöcking.

15:30 – 15:50 Coffee

15:50 – 16:30

Matthias Englert, RWTH Aachen

Reordering Buffers for General Metric Spaces

In the reordering buffer problem, we are given an input sequence of requests for service each of which corresponds to a point in a metric space. The cost of serving the requests heavily depends on the processing order. Serving a request induces cost corresponding to the distance between itself and the previously served request, measured in the underlying metric space. A reordering buffer with storage capacity k can be used to reorder the input sequence in a restricted fashion so as to construct an output sequence with lower service cost. This simple and universal framework is useful for many applications in computer science and economics, e.g., disk scheduling, rendering in computer graphics, or painting shops in car plants.

In this work, we design online algorithms for the reordering buffer problem. Our main result is a strategy with a polylogarithmic competitive ratio for general metric spaces. Previous work on the reordering buffer problem only considered very restricted metric spaces.

We obtain our result by first developing a deterministic algorithm for arbitrary weighted trees with a competitive ratio of $O(D \log k)$, where D denotes the unweighted diameter of the tree, i.e., the maximum number of edges on a path connecting two nodes. Then we show how to improve this competitive ratio to $O(\log^2 k)$ for metric spaces that are derived from HSTs. Combining this result with the results on probabilistically approximating arbitrary metrics by tree metrics, we obtain a randomized strategy for general metric spaces that achieves a competitive ratio of $O(\log^2 k \log n)$ in expectation against an oblivious adversary. Here n denotes the number of distinct points in the metric space. Note that the length of the input sequence can be much larger than n .

This is joint work with Harald Räcke and Matthias Westermann.

16:30 – 16:40 Coffee

16:40 – 17:20

Birgit Heydenreich, Universiteit Maastricht

Mechanism Design for Decentralized Online Machine Scheduling

We study the online version of the classical parallel machine scheduling problem to minimize the total weighted completion time from the perspective of algorithmic mechanism design. We assume that the data of each job, namely its release date r_j , its processing time p_j and its weight w_j is only known to the job itself, but not to the system. In communicating with the system, selfish jobs may thus be tempted to manipulate the outcome by lying. Furthermore, we assume a setting without any central scheduling or routing unit. Instead we assume that the jobs themselves need to choose the machine on which they want to be processed.

In this context, we introduce the concept of a myopic best response equilibrium, a concept weaker than the classical dominant strategy equilibrium, but appropriate for online problems. We present a polynomial time, online scheduling mechanism that, assuming rational behavior of jobs, results in an equilibrium schedule that is 3.281-competitive. The mechanism deploys a very intuitive online payment scheme that induces rational jobs to truthfully report their private data. We also show that the underlying allocation of jobs to machines, which we actually need in order to prove the performance bound, cannot be extended to a mechanism where truthful reports constitute a dominant strategy equilibrium.

This is joint work with Rudolf Müller and Marc Uetz.