Sayan Bhattacharya, Rob van Stee $\hfill$ **SS 2011**

Exercises for Algorithmic Game Theory

http://www.mpi-inf.mpg.de/departments/d1/teaching/ss11/AGT/

Assignment 6 $\qquad\qquad$ Deadline: Mo 26.11.2012

Exercise 1 *Single-minded bidders*

Consider an auction with single-minded bidders who are all interested in at most two items. Show that in this case an optimal allocation can be found in polynomial time.

You need to reduce this problem to a weighted matching problem in general nonbipartite graphs. In the matching problem, you select a set of edges so that no node occurs in more than one edge. The value of the goal function is then the total value of all the selected edges.

a) What should the value of an edge between items A and B be?

b) How do you represent bids for one specific item?

c) How many nodes will there be in the graph? How many edges?

d) What is the running time of your algorithm?

Exercise 2 *Double-minded bidders*

Consider agents that are interested in *two* possible subsets. Explain why each of the following attempts to get a polynomial-time truthful mechanism with a good approximation ratio fail, and what exactly goes wrong.

Player i wants to have either subset S_{i1}^* at price v_{i1}^*, or subset S_{i2}^* at price v_{i2}^*.

a) Use the sorted order from the mechanism for single-minded bidders, but list each player twice (for both of its desired subsets). Apply the greedy mechanism, skipping any player that is already in the set of winners W.

b) From the list under a), remove every second occurrence of an agent, so that each agent is listed only once. Now apply the greedy mechanism.

c) Create an instance of a single-minded bidder auction for every possible set of choices of the double-minded bidders. Run every auction and use the one with the highest social welfare.

Exercise 3 *The shortest path mechanism*

Explain how to calculate the payments for the shortest path mechanism discussed in class. Give an upper bound for the running time of the mechanism, including the calculation of the payment.