Introduction to Game Theory

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Exercise Sheet 11

Due: Thursday, July 18, 2019

Send your solution to `schultet@informatik.uni-freiburg.de` (PDF only) or submit a hardcopy before the lecture. The exercise sheets may and should be worked on and handed in in groups of three students. Please indicate all names on your solution.

Exercise 11.1 (Greedy Mechanism for Single-Minded Bidders, 2 + 2 + 2 points)

Recall that the Greedy Mechanism for Single-Minded Bidders sorts bidders in descending order by $\frac{v_i^*}{\sqrt{|S_i^*|}}$. It has been shown that this mechanism has an approximation factor of $\sqrt{m}$, where m is the number of items. Consider a scenario with five bidder ($N = \{1, 2, 3, 4, 5\}$) and four 4 items ($G = \{1, 2, 3, 4\}$) where the bids be as follows:

- for all $i \in \{1, 2, 3, 4\}$: $S_i^* = \{i\}$ and $v_i^* = 1$, and
- $S_5^* = \{1, 2, 3, 4\}$ and $v_5^* = 2$.

(a) Apply the Greedy Mechanism for Single-Minded Bidders and report the winner set and the social welfare.

(b) Apply the Greedy Mechanism for Single-Minded Bidders but this time sort the bidders in descending order by their prices, i.e., v_i^*. Again, report the winner set and the social welfare.

(c) Show that the approximation factor of the Greedy Mechanism for Single-Minded Bidders is not "better" than m if you sort the bidders in descending order by their prices, i.e., v_i^*. *Hint*: Construct an example with m items where the optimal social welfare is m times better than the proposed solution of the modified Greedy Mechanism for Single-Minded Bidders.

Exercise 11.2 (Question Time, 2 points)

Recap the game theory lectures and, as an answer to this exercise, write down two questions that you want to discuss.