Exam Protocol Algorithmic Game Theory

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2024

Preamble

This protocol contains the questions of one oral exam for Algorithmic Game Theory in the summer semester of 2024.
If you take the exam it would be very cool if you also made an exam protocol.

Congestion Games

Question 0.1 *What is a congestion game?*

Question 0.2 *What is a pure Nash Equilibrium?*

Question 0.3 *How did we show that there always exists a pure Nash Equilibrium? (included writing down the explicit formula of the Rosenthal-Potential)*

Question 0.4 *Can we find PNE in polynomial time?*

Question 0.5 *What is PLS and how can we model finding a PNE as a PLS-problem?*

Mechanism Design

Question 0.6 *What is a truthful mechanism?*

Question 0.7 *How is the requirement of a truthful mechanism stronger than the requirements for a PNE?*

Question 0.8 *What is Myerson's lemma and what does it tell us about truthful mechanisms?*
(including explicitly writing down the payment rule)

Question 0.9 *How does the VCG mechanism operate?*
(including explicitly writing down the payments)

Question 0.10 *Why is the VCG-mechanism always truthful?*

Question 0.11 *Why is the term*

$$\max_{x \in X} \sum_{j \neq i} b_j(x)$$

in the VCG-payments?

Question 0.12 *What does the VCG-algorithm give us when applied to a single item auction?*
(explicitly with explaining who gets the item and how the payments for different bidders turn out to be).

Revenue Maximisation

Question 0.13 *What assumptions on valuations did we add for revenue maximisation?*

Question 0.14 *What equality did we show for the expected revenue?*

Question 0.15 *How did we start the proof for the expected revenue equality*

$$\boldsymbol{E}_v \left[\sum_{i \in N} p_i(v) \right] = \boldsymbol{E}_v \left[\sum_{i \in N} \phi_i(v_i) x(v) \right]$$

(only the initial start of equations)

Question 0.16 *What is a regular virtual valuation function?*

Question 0.17 *How can we algorithmically compute the maximum revenue in a truthful mechanism?*

Question 0.18 *(excourse) Why is truthfulness not a too strong requirement for our revenue maximisation goals?*

Stable Matchings

Question 0.19 *What is a stable matching?*

Question 0.20 *how can we efficiently find a stable matching (and why is the matching produces by the algorithm actually stable)?*