Exercises for Algorithmic Game Theory: Assignment 13
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Problem 1. Prove that no truthful digital goods auction with 2 bidders is the best. In other words, show that for any truthful auction $\mathcal{A}$, there is another auction $\mathcal{A}'$ and input $\vec{v}$ such that the profit of $\mathcal{A}'$ on $\vec{v}$ is higher than that of $\mathcal{A}$.

Problem 2. Prove that the "Profit-Extractor" auction PROFIT-EXTRACT$_R$ is truthful for any given parameter R. Show that it returns a revenue of R if and only if $R \leq \mathcal{F}(\vec{b})$. Here $\mathcal{F}(\vec{b})$ denotes the maximum revenue obtainable from bid-vector $\vec{b}$ with a uniform price.

Problem 3. We have n unit-demand bidders and an item available in unlimited supply. Recall that if the bidders valuations are drawn from i.i.d. distributions, then we can infer the uniform price benchmark $\mathcal{F}(\vec{b})$ from the optimal Bayesian auction.

Now, suppose that the bidders' valuations are drawn from non-identical (but mutually independent) distributions. What will be the analogous prior-free benchmark? Can there be any prior-free auction that is constant competitive against this new benchmark?