Exercises for Algorithmic Game Theory: Assignment 12
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Problem 1. What is the optimal Bayesian single-item auction when the seller values the item at $v_0 > 0$ and the bidders' valuations are independent and identically distributed?

Problem 2. We have an undirected graph $G = (V, E)$, where V is the set of nodes and $E = \{e_1, \ldots, e_{|E|}\}$ is the set of edges. There are $|E|$ bidders $\{1, \ldots, |E|\}$. Each bidder i wants to buy the corresponding edge $e_i \in E$, and her private valuation for the edge is denoted by v_i. The bidders' valuations are independent and identically distributed random variables. The distributions are public knowledge. Finally, we have the constraint that the auctioneer can sell a subset of edges $E' \subseteq E$ only if the subset E' is acyclic.

Give an algorithm for computing the revenue-optimal universally truthful auction in this setting.

Problem 3. We have a single item and n bidders. The private valuation of bidder i is a *discrete* random variable v_i with support $\{1, \ldots, m\}$. The random variable v_i follows a distribution with probability density function $f_i(.)$, so that $f_i(z) = \Pr[v_i = z]$ for all $z \in \{1, \ldots, n\}$. The distributions $f_1(.), \ldots, f_n(.)$ are mutually independent.

Write a linear program for computing the revenue-optimal truthful in expectation auction in this setting.