CS286r Computational Mechanism Design: Project Suggestions Spring, 2005

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1 Class Projects

The goal of the final project is to develop a deep understanding of an important research area, and, to the extent possible, to work on an open problem. You may also review an existing area of the literature, providing a careful and critical comparison of different approaches to computational mechanism design. You are strongly encouraged to build from the discussions in class, and to also remember that there are a few papers still to be covered.

Projects may be theoretical or experimental; theoretical projects must be individual, while experimental projects can be completed in pairs. A list of suggested topics for projects are provided here, but you are encouraged to propose a topic of your own for approval. **Project proposals are due in class on Wednesday, April 13.**

Your proposal will probably not need to be more than a couple of pages in length. Your goal should be to convince me that your ideas are well enough focused, and that you know what the first few steps will be. You should explicitly include the following sections in your proposal:

1. Provide a high-level description of your project.

2. Provide motivation for your proposed work (what will we know afterwards that we don't know now, and why do we care?)

3. Place your work in the context of the papers that we have read in the course.

4. Let me know what things that Laura and I can help with to get you started.

We will meet the **afternoon of Tuesday, April 19**, 1–4pm, to discuss your project choices (I'll leave a sign-up sheet for 15 minute slots outside my office). Project presentations will be 1-4pm on **Monday, May 16**, and your final project report is due at noon on the last day of reading week (Wednesday, May 18), to Arthur Cram, MD 133.

2 Project Suggestions

Many of these projects could be either theoretical or experimental. In addition, in some of these problems there might be a place where you need computational solutions to combinatorial optimization problems (such as winner-determination problems). Expect to be able to use off-the-shelf integer programming software (e.g. CPLEX) for this purpose, that you can call from either Java or C++. Also, please let me know if you need an `eecs` account to perform your work. Thanks to many of you for contributing ideas in your comments on papers.

2.1 Truthful Characterizations and Auction Design

Single-Minded Consider using a norm that is related to the underlying economic value of the bundle in the greedy allocation scheme presented in Lehmann et al [9]. Compare the performance of this norm with that used in LOS on some empirically motivated distributions.

Single-Minded Adjust a variable that measures complementarity in a multi-good auction and see how well the greedy algorithm does against the GVA.

Single-Minded Gather empirical data on running CAs with non-single-minded bidders, using various ways of describing types as sets of single-minded bidders, and see how these decomposition schemes work.

Single-Minded Asess revenue generated by the proposed mechanism/ compute optimal reserve price.

Truthful characterization. Experiment with the threshold M used in the proof of Theorem 3 in Lavi et al. [7].

Externalities Design a bidder language for CAs that can specify externalities.

3 Alternative Solution Concepts

False-name bid proof. Survey work (by Makoto Yokoo and others) on false-name bid proof mechanisms. Suggest how the results differ from those when we are not concerned with false-name bid proof, and suggest things that are missing in the current literature.

False-name bid proof. Implement the false-name-proof protocol from Yokoo [12], and analyze the running time, efficiency, and revenue properties.

False-name bid proof. Explore computational issues with PORF (comparative computation / approximation times vs. SP protocols), or questions regarding the size of the design space for WAP vs. NSA vs. FP protocols.

False-name Bid Proof. Characterize the relationship between false-name-proof and collusion-proof.

False-name Bid Proof. Extend the framework to randomized CAs.

Envy-free auctions. Implement the $CORE_R$ and $CORE_C$ auctions from “Envy-Free Auctions for Digital Goods” [1] and compare the optimal economic profit and the worst-case profit when there exists noisy (i.e. incorrect) priors.

Envy-free auctions. Extend the analysis from Goldberg and Hartline to a non-digital good setting (relax unlimited supply and/or single-parameter).

Envy-free auctions. Complete a comparative study of loss of social welfare imposed by the envy-free property.

Envy-free auction. Explore the tension between envy-free property/ truthfulness and competitiveness. Can better results be achieved with prior knowledge of the distribution?

Budget-constrained bidders Relax the hard budget constraint from Borgs et al. citeborgs05. Allow bidders to borrow money.

Budget-constrained bidders Extend the analysis to risk-averse bidders.

Budget-constrained bidders Relax constant marginal valuation assumption.

Budget-constrained bidders Examine theoretically or empirically the implications of consumer sovereignty and IIA for (m, n)-multi-unit budget constrained auctions.

Collusion-resistant auctions Explore the tradeoff between truthfulness and collusion-resistance. Can proxy agents be designed in collusion-proof ways?

Collusion-resistant auctions Examine tradeoff among efficiency, revenue maximization, and collusion resistance.

Collusion-resistant auctions Compare group strategyproof mechanisms with t-truthful mechanisms with high probability in terms of complexity.

collusion-resistant auctions Extend the analysis from Goldberg and Hartline [4] to a multi-parameter setting.

4 Privacy

Privacy-Preserving Auctions. Propose a definition for partial information revelation (see the future work section in Brandt and Sandholm [3]), and explore its implications.

Privacy-Preserving Auctions. Characterize privacy-preserving auctions in a similar framework as truthful mechanisms are characterized in the Lavi et al. [7] paper.

Privacy-Preserving Auctions. Complete an analysis of whether privacy can be guaranteed within subsets of people, where the subsets may or may not include the auctioneer.

Privacy-Preserving Auctions. Consider the case where we have a self-interested adversary instead of a honest but curious one. Study the relationship between cryptographic adversary models and game-theoretic adversary models.

Privacy-Preserving Auctions. Explore relationship between collusion in the game-theoretic sense and privacy (collusion in the information-theoretic sense)

privacy Instead of imposing privacy as a hard constraint, consider incorporating the cost of privacy into the objective function.

5 Automated Mechanism Design

AMD Game-theoretic analysis of credibility problem what arises between the designer and the agents in the AMD setting.

AMD For certain classes of utility functions, can we formulate and solve a non-linear optimization problem with constraints and eliminate the requirement for a finite number of types?

AMD Develop a model of a multi-stage mechanism that is not so dependent on the prior, where information about the bidder distribution is gathered in the first stage and used in a later stage for solving the allocation and payments.

AMD Examine tradeoff between prior knowledge and the approximability of AMD.

AMD Sensitivity analysis: what happens if the priors are off by x%?

Optimal CAs Empirical analysis using distributions other than uniform.

Optimal CAs Sensitivity analysis: what happens if the priors are off by x%?

Optimal CAs Determine how the revenue generated by their method compares to the optimal reveuene (find a bound). Compare their experimental results with a simple priced-based scheme.

Optimal CAs Look for smaller class of mechanisms that are more efficiently solvable and could yield a reasonably profitable mechanism.

Optimal CAs Extend computational analysis to the case where the number of samples in the algorithm can be dynamically tuned.

Optimal CAs Can we add additional structure to the problem to make the problem more scalable?

6 Online Auctions

Online Auctions Perform an empirical analysis of one of the online auctions in Porter [10], Lavi and Nisan [8], or Hajiaghayi et al. [5].

Online Auctions Extend one of the models of online auctions to make it more realistic, e.g. to handle a grid scheduling problem.

Ad-Auctions. Extend one of the models of online auctions to better model the ad-auctions problem (see also Saberi et al. [11]).

Preference Elicitation. Investigate the PAC learning model and look at its relationship with preference elicitation.

Preference Elicitation. Investigate whether one can use computational learning theory techniques to elicit an XOR/OR valuation.

Preference Elicitation. Conduct an empirical investigation into the limited-Precision auctions of Kress and Boutilier [6].

Preference Elicitation. Design an incentive-compatible method to elicit bid taker non-price based preferences (building from Boutilier et al. [2]).

References

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