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Preface

This volume contains the papers presented at WINE 2012, the 8th Workshop on Internet and Network Economics, held on December 10–12, 2012 in Liverpool, UK.

Over the past decade, there has been a growing interaction between researchers in theoretical computer science, networking and security, economics, mathematics, sociology, and management sciences devoted to the analysis of problems arising from the Internet and the World Wide Web. The Workshop on Internet and Network Economics (WINE) is an interdisciplinary forum for the exchange of ideas and results arising from these various fields. At the time of writing, WINE 2012 had just been approved for "in cooperation" status with ACM SIGecom (ACM's special interest group on electronic commerce).

In the Call for Papers we solicited regular papers (14 pages) and short papers (7 pages). We received 112 submissions, from which we accepted 36 regular and 13 short papers. As for WINE 2011, we also allowed submissions to be designated as working papers. For these papers, the submission was assessed in the same way as other papers, but only the abstract has been published in the proceedings. This allows subsequent publication in journals that do not accept papers where full versions have previously appeared in conference proceedings. Of the 49 accepted papers, 3 are working papers. All papers were rigorously reviewed by the program committee members and/or external referees; each received at least 3 detailed reviews. Submissions were evaluated on the basis of their significance, novelty, soundness, and relevance to the workshop.

Besides the regular talks, the program also included three invited talks by Kamal Jain (eBay Research Labs, USA), Benny Moldovanu (University of Bonn, Germany) and David Parkes (Harvard University, USA). The conference organizers also hosted tutorials on the day before WINE, on topics of interest to the community: an introduction to the GAMBIT software by Rahul Savani and Ted Turocy; a talk entitled "An Overview of Matching Markets: Theory and Practice" by David Manlove, and an introduction to Judgement Aggregation by Ulle Endriss.

We are very grateful to Google Research and Microsoft Research for their generous financial contribution to the conference. We also thank the Department of Computer Science at the University of Liverpool for their financial contribution and organizational support.

We also acknowledge Easychair, a powerful and flexible system for managing all stages of the paper handling process, from the submission stage to the preparation of the final version of the proceedings.

October 2012

Paul W. Goldberg
Mingyu Guo

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An Introduction to the Algorithmic Game Theory of eBay's Buyer-Seller Matching (Invited Talk)

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Abstract

Buyer-seller matching is a widely used problem. It is a problem of Google's (ads) and Amazon's; and it is also a problem of traditional retailers such as Walmart and Costco. In the offline world a traditional retailer is trying to match the products supplied by the manufacturers to the interested buyers. In the case of a traditional retailer this matching is a static matching done once for all the buyers. In the online world, it is possible to do this matching for every potential buyer, perhaps based on their expressed (e.g., based on a search query) or implied (e.g., based on a browser cookie) intent. eBay is perhaps the first major company to start such a buyer-seller matching online; hence the title. The presentation is based on buyer-seller matching from a viewpoint of electronic commerce industry in general. This includes search ads, online retailers, and online marketplaces.

There are various issues arise in buyer-seller matching perhaps many of them could be captured by the trade off between Relevance and Revenue. *Relevance* is broadly defined as the expected net utility of a seller's offering (known as *listing* on eBay) to a potential buyer at a given price. Decreasing the price of an offering increases the relevance while increasing the price decreases it. So essentially selling any item at a very high price can make an offering completely irrelevant. *Revenue* is defined as the expected fee charged by the company doing the matching, e.g., by eBay. The company doing the match is henceforth called an *intermediary*.

There are two major strategic decisions an intermediary makes; 1. on what event(s) a fee is charged for doing the matching; and 2. what criteria to use to decide the order of listings to display to a potential buyer. There are many different choices being made in the industry. eBay charges a fee at the time of including a listing in its index and then again when the product listed is bought by a buyer. Google charges a fee when a potential buyer clicks on an advertisement and lands on a seller's page. Walmart charges its fee as a markup on top of the wholesale price it gets from its suppliers. Costco charges its fee when a potential buyer registers with it and also as a markup on top of the wholesale price it gets from its suppliers. How these fees are charged and on what order a potential buyer sees the listings have a tremendous influence on the selection of

products a buyer sees and as well as the prices a buyer sees. For an example, it can be proven that given risk-neutral sellers and given that the same amount of expected revenue is made by the intermediary, if the intermediary fee is charged as a sale's commission versus a statistically equivalent fee charged on a click, then the net price a buyer sees is higher in the former pricing structure. The reason being that a click fee is sunk cost for the seller while a sale's commission is marginal cost. This is not true if the sellers are risk averse, which is often the case with small sellers. Small sellers may not have know-how or may not be able to afford to hire help to manage their risk. So despite higher prices to potential buyers, fee charged as a sale's commission may offer a bigger selection to a potential buyer than a statistically equivalent fee charged on a click.

When a problem space is defined by two separate parameters, such as Relevance and Revenue in our context, then it is often the case that one could define various notions of optimality. One of the simplest notions is perhaps ignoring one of the parameters altogether. So one question we ask is how to optimize the expected revenue for the intermediary, given a strategic buyer and sellers. A paper with Chris Wilken [2] looks at this problem. Given that a buyer probably has a limited attention span, the paper considers various conceptual models of a buyer's attention. A full attention model is when a buyer considers all possible listings before deciding what to purchase. On the other end of the spectrum, a buyer considers only 1 listing and decides whether to purchase it or not. The paper shows, in a very general Bayesian setting, that if the attention model is known then finding a revenue optimal mechanism is essentially an algorithmic problem, since game-theoretic properties are automatically satisfied. In other words the paper proposes an optimal mechanism for a general setting given unlimited computation.This is not necessarily true for approximately optimal algorithms. This is because the optimal algorithms result in some kind of monotonicity properties which are often needed to prove incentive compatibility, but approximation often lose the monotonicity. The paper proposes incentive compatible approximately optimal mechanisms for a set of attention models.

Another practical generalization of this setting is to associate multiple sellers with the same listing. When an item is sold often there are multiple sellers behind the item who benefit from the sale. For an example, if Best Buy sells a computer made by Samsung having Intel processor and Windows OS then all 4 companies benefit. Currently the surplus of only the last agent, Best Buy in this example, is directly represented in the matching marketplace. In reality all these 4 sellers are bundled together, because a computer is a bundled product. Separately, there are also settings where the buyers are bundled, e.g., Groupon purchases are executed when a certain number of buyers commit to a purchase.

A paper with Darrell Hoy and Chris Wilkens [1] introduces an ad matching auction where an ad benefits multiple sellers. The industry seems to be evolving in the direction where it is the products whose ads are auctioned rather than just sellers' ads, e.g., Google's search pages now also show the ads of products, besides the ads of the webpages of sellers. In product auction setting, one can conceive that in future the interest of various parties who benefit from the sale

of the product could be represented in the marketplace to enhance both the revenue and relevance. This is indeed quite feasible in a marketplace like eBay which anyway displays specific products.

In general, in an auction setting when there are complementary bidders, the revenue for the auctioneer could be as little as zero. This paper [1] demonstrates that the first price auction has a minimum revenue guarantee at equilibrium. Even newer results demonstrate a bidding language which allows pure strategy equilibria in the first price auction, thereby fixing a historic flaw when the first price auction was used by Overture in ad-auctions. Overture's first price ad-auction did not always have a pure strategy equilibrium, thereby causing a cyclic behavior by the bidders. Subsequent work also demonstrate how a first price auction could converge to an equilibrium.

References

1. Hoy, D., Jain, K., Wilkens, C.A.: Coopetitive ad auctions (2012), http://arxiv.org/pdf/1209.0832.pdf
2. Jain, K., Wilkens, C.A.: ebay's market intermediation problem (2012), http://arxiv.org/pdf/1209.5348.pdf

On the Equivalence of Bayesian and Dominant Strategy Implementation (Invited Talk)

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Abstract. We consider a standard social choice environment with linear utilities and independent, one-dimensional, private types. We prove that for any Bayesian incentive compatible mechanism there exists an equivalent dominant strategy incentive compatible mechanism that delivers the same interim expected utilities for all agents and the same ex ante expected social surplus. The short proof is based on an extension of an elegant result due to Gutmann et al. (Annals of Probability, 1991). We also show that the equivalence between Bayesian and dominant strategy implementation generally breaks down when the main assumptions underlying the social choice model are relaxed, or when the equivalence concept is strengthened to apply to interim expected allocations.

Joint work with A. Gershkov, J. Goeree, A. Kushnir and X. Shi.

New Applications of Search and Learning to Problems of Mechanism Design (Invited Talk)

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Abstract. When faced with a hard optimization problem, common approaches are to either design a polynomial-time approximation algorithm, or design a heuristic algorithm (perhaps search-based) that is fast enough, and generates solutions of high enough quality, to be of practical interest. But the main focus in algorithmic mechanism design has been on the first, "polynomial + approximation" direction, with the requirement of truthful mechanisms tending to impede progress in the second (heuristic search) direction. In this talk I describe two ways in which heuristic algorithms can be leveraged within mechanism design. One approach is to modify branch-and-bound search to make it monotone in the input, enabling search to be used as a building block for single-parameter, truthful mechanisms on NP-hard problems, and even without running to optimality. A second approach, which applies also to multi-parameter domains, takes as input a particular allocation algorithm. Given this algorithm, statistical machine learning is used to identify a payment rule that minimizes expected ex post regret for deviating from truthful reports. A direct connection is established between this "minimize ex post regret" problem and the problem of training a multi-class classifier to minimize generalization error. By relaxing truthfulness, this opens up a new direction in coupling "almost implementable" allocation algorithms with suitable payment rules.

This talk is based on two papers: Monotone Branch-and-Bound Search for Restricted Combinatorial Auctions, by John K. Lai and David C. Parkes, in Proc. 13th ACM Conference on Electronic Commerce (EC '12), 2012, and Payment Rules through Discriminant-Based Classifiers, Paul Duetting, Felix Fischer, Pichayut Jirapinyo, John K. Lai, Benjamin Lubin, and David C. Parkes, in Proc. 13th ACM Conference on Electronic Commerce (EC '12), 2012.

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