Databroker System: A New Online Advertising System That Keeps Users Engaged While Preserving Their Privacy

(Demonstration)

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1. THE DATABROKER SYSTEM

1.1 The Video URL

https://youtu.be/W5kACAOUjWY

1.2 The Application Domain

In 2013 Online advertising generated $42B worth of revenue and more than 3.4 million direct and indirect jobs in Europe alone. The online advertising industry supports some of the most important Internet services such as search, social media and user generated content sites. However, the lack of transparency regarding tracking techniques and the type of information companies collect about users is creating increasing concerns in society. Software tools for implementing total mitigation (e.g., ad blockers and anonymizing services) are able to limit or block the transfer of information from end users to the online advertising ecosystem. Broad adoption of these tools by end users may cause disruptions in the digital economy by affecting the online advertising sector and leading to consequences such as layoffs. Based on this motivation we introduce a new foreseeable future advertising model. Our suggested databroker system takes an alternative approach to preserving users' privacy based on game theoretic principles. The game theoretic approach to preserving users' privacy allows for the maintaining of desirable economic properties in the advertising market. The databorker system serves as a privacy-incentive based interface between end-users and online advertising platforms. Specifically, end-users will provide the Data Broker with the only information they wish to share with the market. The data broker will then engage in the advertising market, selling access to end-users and end-users' information, while guaranteeing end-users' anonymity. To encourage end-users to share as much information with the advertising market, the data broker will pay awards to contributing end-users as a function of the price paid to the broker by the advertising market.

1.3 The Problem Scenario

The Databroker system is modeled as a market setting where advertisers are buy agents, users are sell agents (agents willing to sell their own information) and information brokers mediate between advertisers and users. The objective of such a system is to end up with a match between selling agents (users) and buying agents (advertisers) that maximizes the gain from trade. Towards that goal, the system has to collect information from the mediators (information brokers) and buying agents (advertisers); and thus, needs to incentivize the mediators and advertisers to truthfully report, which it does by charging the advertisers and paying the mediators. Additionally selling agents (users), are assumed to be strategic, which requires the system to incentivize them by recommending each mediator to forward some of the payment he received to his users. In practice, payments from brokers to users is encouraged by creating competition between brokers for the loyalty of their users.

The Databroker demo implements some of our theoretical solutions suggested in [5]. From a motivational point of view our model is closely related to models that involve mediators and online advertising markets, such as the models studied by [1, 4, 7]. However, despite their motivation by a network exchange, these models are actually auctions (i.e., one-sided mechanisms).

1.4 The Multi-Agent Techniques Involved

A natural expectation from a dynamic market system is to (approximately) maximize the gain from trade, while guaranteeing desirable economic properties such as incentivizing truthful biding, voluntary participation and avoiding budget deficit. Unfortunately, as far as we know, no previous theoretical work has managed to achieve these goals simultaneously. Wurman et al. [8] presented a mechanism incentivizing truthful reporting from either the buyers or the sellers, but not simultaneously from both. A different mechanism given by Blum et al. [2] maximizes the social welfare of buyers and non-selling sellers (as opposed to maximizing gain from trade). Finally, Bredin et al. [3] present a truthful dynamic double-sided auction that is constructed from a truthful offline double-sided auction rule. However, the competitiveness of [3]'s mechanism with respect to the optimal trade was not proven theoretically.

The failure of the above works to maximize gain from trade while maintaining truthfulness, individual rationality (voluntary participation) and budget balance (avoiding budget deficit) can be partially attributed to [6]'s impossibility result. This impossibility result states that, even in an offline

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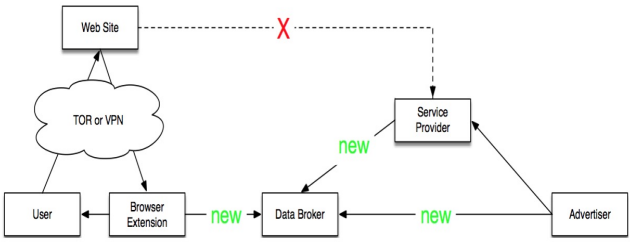

Figure 1: The System Overview Architecture

setting involving a single buyer and a single seller, maximizing the gain from trade while maintaining truthfulness and individual rationality perforce runs a deficit (i.e., is not budget balanced). An additional reason for the above failure is that the matching problem faced by the market maker (of the system) in multi-sided dynamic markets combines elements of dynamic algorithms and sequential decision making with mechanism design considerations. This demo presents the first[1] dynamic system for a multi-sided market setting which guarantees the economic properties of truthfulness, individual rationality, and budget balance while (approximately) maximizing the gain from trade. Our setting involves multi-dimensional agents, thus our result shows that dynamic multi-sided markets can be handled even in the presence of multi-dimensional agents.

1.5 The Technology Used

The most certain path to bringing about data brokers in actuality, that does not involve government regulation, is for data brokers to offer the service of anonymizing users in exchange for the right to target them with advertising. Our system behaves roughly as depicted in Figure 1.

We developed the following components to implement or system. Generally, the graphical interfaces are implemented in javascript and HTML using the MEAN stack and the algorithmic portions of the project were implemented in python. RESTful interfaces were also deployed in situations where a web API was needed.

- A web site that allows end-users to communicate information of their choice to the data broker. The interface elements guide the user through retrieving information about their market segment/user cluster (e.g., gender, age, marital status, parents to kids, topics of interest, etc).

- A data broker website interface that allows the service provider/advertisers to bid on the data broker's end users' cost for sharing pieces of information in the advertising market.

- A chrome plugin to serve as an ad blocker and intermediate between the user's web client and the Databroker. This allowed us to block advertising from the service provider and place new advertising in its' place. In a practical deployment chrome would be replaced by an anonymous browser using TOR to completely stop service providers from tracking users.

[1]To the best of our knowledge.

1.6 Databroker System Innovations

The Databroker system innovates in three ways: Firstly, it guarantees privacy by default since only those pieces of data that the user is willing to share will be passed to the Data Broker and thus forwarded to the online advertising market. Secondly, current strategies to profile end-users are based on tracking techniques. However, no single tracker is present in all websites and thus they all potentially miss some of the user's online activity. The Databroker takes a different approach and receives information directly from end-users and is thus more accurate. In addition, algorithms that infer user's interests from their browsing behavior are typically based on heuristics that in many cases lead to an inaccurate prediction of the end-user's actual interests. The demoed Databroker system addresses the mentioned issues and provides accurate information regarding the interests of end users (i.e., the information is directly provided by the end user). Thirdly, the Databroker encourages end users to willingly share more of their data by providing price-incentive awards after engaging in auctioning their profile anonymously.

1.7 The Databroker Live & Interactive Aspects

The Databroker system incentivizes users to proactively engage with online advertising systems. There are four major roles in the system the: (1)User - offers the databroker demographic information about themselves as well as main interests and places a bid valuation for this information. (2)Databroker - receives bids from users, engages in the advertising market while anonymizing his users' identity and sells advertising space on the user's behalf. (3)Advertiser - creates advertising campaigns targeted to user demographics and interests. (4)Researcher - conducts behavioral experiments, which include testing the strategic behavior of each roll and its equilibrium implications.

The databroker system allows users to browse the web, observe advertisements and follow the resulting payments that accumulate in their accounts. The system allows databrokers to create multiple different groups of users to participate in the online advertising market. The progress of these groups can be followed on a dashboard that allows the databroker to analyze inbound and outbound payments to the advertising system as well as to specific groups and users. The databroker system also allows advertisers to create advertising campaigns that target users with similar portfolios or target users with mixed portfolios. The advertisers, similar to the users and databrokers, can observe a dashboard showing all of the payments they made to the advertising system and group this data by campaign.

In an illustrative scenario, an end user may log in to databroker browser extension, enter demographic information and volenteer his interest in audio equipment. The extension interface then suggests a bid to the user and the user adjusts the bid to his liking. Thereafter the extension blocks ads on web pages and replaces some with in-context advertising for audio equipment. The advertiser pays the databroker for these impressions and the databroker passes along a portion of these payments to the user. The user can track these payments in his web interface.

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