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Incentives and Gamification

Think back to all of the computer programs you have ever written. Prompting the user for some input (or more generally, reading input) is probably something each and every one of those programs did at some point. (Well, except for the very first one, which only printed "Hello, world!") For example, one of the first computer programs you wrote probably asked the user for their birth date, and proudly printed which day of the week it was. But, one question that probably never crossed your mind while writing this program was: "What if the user lies and does not provide their real birth date?" Similarly, whoever programmed your favorite email client probably never asked themselves, "What if the user lies and intentionally inputs a wrong email address for one of the recipients?"In contrast, if you were asked to design an auction website, you would probably consider the possibility of a user misreporting the maximum amount they are willing to pay for the rare first issue of *XRDS*. You would ask yourself how you could incentivize the user to be truthful when reporting this value. Similarly, if you were asked to design a traffic-navigation app such as Waze, you would probably ask yourself how you could motivate the user to report accidents (or even to keep the app open when they don't need directions at all). In both of these examples, the program has to incentivize or motivate the user to provide the desired input, and cannot just assume the input will be given, as is the case with the birth date program or the email client.

The auction and traffic navigation scenarios come from two fields that have evolved quite separately from one another. In algorithmic game theory it is customary to assume users give you the input that gives them their most-preferred outcome (e.g., win the auctioned item for the least amount of money).[1] In gamification users require motivation to enter meaningful input, or even to interact with a program to begin with.

When hearing the terms "game theory" and "gamification" for the first time, they may sound almost synonymous. Interestingly, though, the word "game" has a very different meaning in each of these terms. The "game" in game theory is any interaction where one can "cleverly" choose their action (usually to optimize their outcome). The "game" in gamification is a fun pastime activity, from which one can borrow elements and themes that help engage users. Despite the separate evolution of each of these fields, and the different meaning of the term "game" in each of them, a central theme in both of these fields is incentivizing, or motivating, users to act in certain ways. The articles that comprise this issue of *XRDS* aim to introduce you, our reader, to a diverse but representative sample of scenarios from the worlds of algorithmic game theory and gamification, where a program or algorithm aims to incentivize or motivate some users to act in a certain manner. In a world where many computing systems interact with anonymous users from across the globe, such concerns become more central than ever before.

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INCENTIVIZING TRUTHFULNESS

Algorithmic mechanism design is the subfield of algorithmic game theory that is concerned with designing new algorithms whose properties incentivize the users to truthfully report their inputs to the algorithm, such as in the previous auction example. Possibly the "holy grail" of algorithmic mechanism design is finding "black-box reductions," that is, generic recipes for taking any algorithm for a certain optimization problem,

1 The field of game theory analyzes interactions where participants are strategic about their actions. The field of algorithmic game theory lies at the intersection of economics and game theory on the one hand, and computer science on the other hand, and studies game-theoretical questions within the context of computing.

2002 The year "gamification" was coined by Nick Pelling, a British computer programmer.

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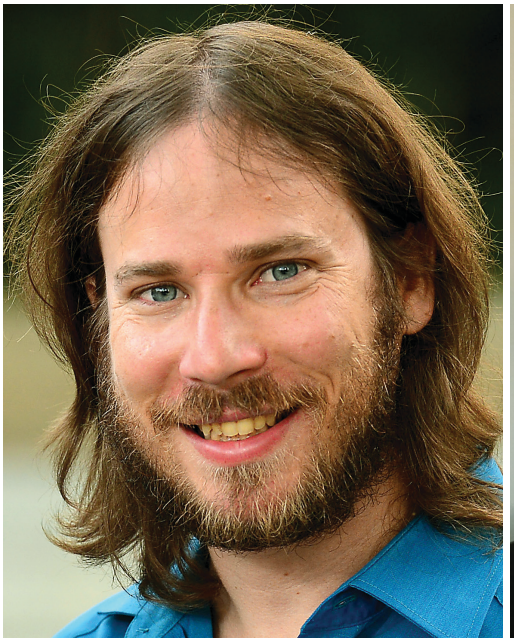
and making it immune to strategic manipulation of the input, with negligible loss in performance. Rad Niazadeh gives us a glimpse into the fascinating study of this class of problems, which, even though its fundamental techniques can be traced back to the 1960s, has seen enormous and fundamental advances in the last decade.

A major theme of research in economics and algorithmic game theory is that of fair division, where the goal is to divide goods or resources between several participants, who may each have different values for each of the goods, in a way that satisfies some fairness properties. As fascinating as the theoretical study of such problems may be, it would completely miss its purpose if it were left in the lab. Nisarg Shah tells us about Spliddit.org, a website that gives any person with internet access, regardless of their background or education, convenient access to many fair division algorithms. Spliddit has attracted more than 100,000 visitors in the two and a half years since its launch, and has found fair solutions to more than 35,000 problems. Why not give it a try the next time you need to divide rent, goods, chores, credit, or fare?



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More often than not, we do not get to design the markets or mechanisms that we study. Even in cases in which mechanisms that incentivize truthfulness exist, it may be the case that the actual mechanisms used, whether for historical reasons or otherwise, do not incentivize truthfulness. One such prominent case is perhaps the most profitable application of algorithmic mechanism design: ad auctions. These are the auctions performed by Google and Bing among advertisers to decide which ads are shown to you on the search-results page. Given an auction that does not incentivize truthfulness, classic economic theory advocates the bids given by the different bidders would be in a state of Nash equilibrium, i.e., in a steady state wherein each player best responds to the bids of the others. In her article, Gali Noti explains that when a Nash equilibrium is hard to compute or not unique, this may not be the case. She explores alternative predictions for how bidders may bid, and backs these up with empirical data.

One of the truly remarkable things about basic research is that tools developed for one purpose in one field sometimes find a completely different purpose in another quite distant field. The history of science is dotted with such stories. Rachel Cummings tells us about the surprising usage of differential privacy—a tool originating in the world of databases—to design manipulation-resistant mechanisms. Maybe you, our reader (yes, you!), could be the one who finds a novel use for some tool from your field within the context of incentives?

$79.4B Google's 2016 ad revenue thanks to its AdWords service, which decides what ads to display to each user by running an auction among the various advertisers.

INCENTIVIZING ACTIONS AND EFFORT

Sometimes, to gather information, an application must incentivize the user not only to provide information that they have, but also to act in a certain way to obtain this information. For example, in order for a traffic-navigation app to know whether a given road is congested, it must incentivize at least one user to drive through that road. Imagine such an app tells you that road A to your university is traffic free today, but it knows nothing about the congestion of road B—it could be even better, but this is quite a rare event. Would you hazard taking road B? If neither you nor others would do so, how can the app find out whether road B in fact has less traffic? Is there any recommendation policy this app could follow that would both recommend you take road B and incentivize you to trust this recommendation, even if you are fully aware of this policy? In his article, Alex Slivkins explains how such a surprising policy can be constructed.

The emergence of crowdsourcing platforms, such as Amazon Mechanical Turk, enables us to harness human computation to solve tasks that are difficult to solve with computers alone. For many such tasks, we can ensure the quality of the results by giving the same task to a number of workers and aggregating the responses. Unfortunately, in many cases, such as that of open-ended questions, it's not clear there are reasonable ways to aggregate responses. Jennifer Wortman Vaughan explores the performance of various suggested schemes to incentivize workers to produce higher-quality results, mitigating the effects of the inability to aggregate responses by such workers.

MOTIVATING PARTICIPATION

In the last decade, we have seen a sharp rise in the availability of digital businesses, mobile- and location-based applications, personal trackers, and online communities, among other kinds of virtual products. At the same time, the companies and developers behind these systems began to realize success depends not only on the quality of the system, but also on the users' motivations to interact with it. In contrast, games were known to be fun and engaging by nature; after all, players usually engage with them completely at their own will. Therefore, academics and companies both began to investigate how to transport the motivational elements of games to non-game applications, leading to the gamification phenomenon. Lennart Nacke, head of the HCI Games Group at the University of Waterloo, and Chair of the Steering Committee for ACM's CHI PLAY conference series, discusses how this happened, as well as the topics that are still open for investigation in this subfield of human-computer interaction.

There are many application areas where gamification is used to motivate and help users achieve their own life goals. One of these areas is health and fitness. Within this domain, gamification is used to motivate individuals to initiate, adhere, and maintain healthy behaviors. Dennis Kappen and Rita Orji review some of the most common game elements used to achieve these goals, such as rewards, competitions, and challenges, and provide many examples of well-known applications that use gamification to help users improve their health.

Finally, the use of incentives and gamification raises important ethical questions. If applications are leading users to act in a certain manner, is this a form of manipulation? What are the responsibilities of the designers in this context? In the closing article, Andrzej Marczewski answers these questions from a practical point of view, and suggests a basic framework for discussing the ethics of gamification.

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Biographies

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