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A game-theoretic analysis of rank-order mechanisms for user-generated content [☆]

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Abstract

We investigate the widely-used *rank-order* mechanism for displaying user-generated content, where contributions are displayed on a webpage in decreasing order of their ratings, in a game-theoretic model where strategic contributors benefit from attention and have a cost to quality. We show that the lowest quality elicited by this rank-order mechanism in *any* mixed-strategy equilibrium becomes optimal as the available attention diverges. Additionally, these equilibrium qualities are higher, with probability tending to 1 in the limit of diverging attention, than those elicited by a more equitable proportional mechanism which distributes attention in *proportion* to the positive ratings a contribution receives, but the proportional mechanism elicits a greater number of contributions than the rank-order mechanism.

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1. Introduction

There is a proliferation of user-contributed content on the Web, and a multitude of instances where user-contributed content adds significant value to websites. The product reviews written by users on Amazon, for instance, are a very valuable component of the service that Amazon provides, while online question-and-answer sites such as Yahoo! Answers and StackOverflow, or sites aggregating service reviews such as Yelp owe almost all their utility to contributions from users. But while there is a large amount of user-contributed content online, not all of it is of the same *quality*—some content is excellent, while some is mediocre and some is outright bad.

Many websites attempt to *rank* content according to its quality, using thumbs-up/thumbs-down style ratings by viewers—this is the case, for example, with comments on Yahoo! News, reviews on Amazon, and posts on Reddit. These websites display higher quality contributions more prominently by placing them near the top of the page and pushing lower quality ones to the bottom. Since content displayed near the top of the page is more likely to be viewed by a user, ranking good content higher leads to a better user experience. But there is also another aspect to displaying better content more prominently: it potentially provides an *incentive* to produce high quality content that might appeal to a contributor's desire for attention. In other words, how contributions are displayed as a function of their estimated quality constitutes a *mechanism* for allocating attention, which might affect the incentives of contributors and influence the quality of their contributions.

What can we understand, using a game-theoretic approach, about how the mechanism used to display content influences the quality of the contributions? In particular, how does the choice of mechanism influence quality when the number of potential viewers, and therefore the potential available attention, grows very large? The diverging attention regime is arguably the most important setting for user-generated content. First, these are the situations where delivering high quality content matters the most for viewer welfare. Second, the popular sites are the ones that draw the most attention-motivated contributors, as well as the ones that tend to attract contributions of varying quality. Indeed, tremendously large amounts of attention are not uncommon for popular content on the web; for instance, the most popular YouTube videos have been viewed over a hundred million times and even days-old 'trending' videos have hundred of thousands of views.

In this paper, we analyze two mechanisms that use viewer ratings to allocate attention to content—the widely used rank-order mechanism, where contributions are allocated positions on the page in decreasing order of their ratings, and a *proportional* mechanism [10,14], which distributes attention in proportion to the number of positive ratings. The rank-order mechanism is ubiquitous throughout the Web, while the proportional mechanism is a natural and more 'fair' alternative: if two contributions receive very similar numbers of votes, it only seems fair that they receive similar amounts of attention as well, but this need not hold in the rank-order mechanism. Furthermore, the proportional mechanism is a mechanism whose implementation is widely discussed in various online contexts such as online question-and-answer forums [14], resource allocation problems [3,25], network-rate control [17,18], online auctions [21], and scheduling [26]. What happens to equilibrium quality and participation in the rank-order mechanism as the amount of available attention diverges, and how does it compare against the more fair proportional mechanism?

Our contributions We analyze equilibrium behavior in the rank-order mechanism in a game-theoretic model where contributors are motivated by attention and have a cost of participation

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