

# Providing Rating Services and Subscriptions with Web Portal Infrastructures

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## INTRODUCTION

A Web infrastructure (portals) for providing online rating of services such as financial services, are becoming more popular nowadays. A rating portal providing comparisons between competitive services has the potential of becoming a well-established Web enterprise. For some services, the comparison is performed based on a set of measurable values such as performance and price, for example, when the service involves computer hardware. In such an environment, services can make a rational decision whether they wish to advertise on the portal based on the set of measurable values (compare with Tennenholtz, 1999). However, for some services like banking, brokerage, and other financial services characterised by such parameters as customer support quality, it is impossible to establish an objective set of measurable values. In these cases, the rating portals publish their scores for the competing businesses based on their own private estimation strategy. We believe that evolution of the interactions between the agents being rated and rating agents is an important social process, which is worth examining thorough simulation.

In this study, we simulate the plausible interaction between portals and services using a simplified model, and we analyse possible scenarios of how services can influence the portals' rating system. Our approach is based on a straightforward revenue model for rating portals, where they require the rated services to be paying to these portals in order to obtain a rating. Within this model, we follow the dynamics of how the competing services may influence the portals to improve their respective ratings.

Over the last couple of years, the role of paid advertisement placement at Web portals has dramatically increased. Until recently, there were just one or two such advertisements per customer query displayed on keyword search portals. Nowadays, after Google's IPO, the business model of paid placement has become very popular, and the majority of search engines have designated areas for displaying advertisement slots on their search results Web pages. This number

of advertisement placements is expected to be growing even faster, and their order (from top to bottom) may be interpreted by users as a rating by a respective search portal. This is due to the fact that it is hard for end users to access the pricing policy for paid placements at keyword search portals (Sherman 2004). Therefore, possible mechanisms of providing such ratings and their evolution are worth exploring.

We conduct the *what-if* study suggesting a simple model with rational agents for services and portals as possible for a simulation of the subscription model. This model is implemented and analysed in detail in Galitsky and Levene (2005). The resultant behaviour is verified and analysed with respect to the possibility of extracting patterns of rating subscription-based behaviour from real publicly available data. We conclude the article with a discussion of how the predicted subscription process fits into the current advertising models; also, the process itself is considered from the standpoint of conflict resolution in multi-agent systems.

## AN ECONOMIC MODEL

Portals are primarily characterised by their reputation. To express this quantitatively, we refer to the difference between the average rating of each service and the individual rating of each service on each portal. The higher the portal's reputation, the more potential customers it has and higher the number of Web surfers who would follow the portal's recommendation to select a particular (top-rated) service. Also, the higher the portal's reputation is, the higher is its appeal for the services to be rated by this portal, and, therefore, the potential revenue stream for the portal is higher. At the same time, when a portal accepts resources from the services rates, its reputation may drop because its rating may become less objective. The dynamics of such a process is the subject of this study.

Each portal, while having its own rating system, aims to *maximise* its revenues on the one hand, and on the other hand, aims to deviate as little as possible from the *average*

portal rating. The justification for this is that often the public perceives the average (or typical) rating (or opinion) as the most trustworthy (Myung & Pitt, 2003).

Evidently, services' ratings by portals is public information. A portal accepts an offer from the service, which has a highest rank by the rest of portals, selecting among all services, which offer a subscription payment.

Our model reproduces the real-life conflict between the services and portals: each service is determined to improve its ratings irrespectively of how it affects a portal's reputation, and vice versa, each portal wishes to achieve a higher reputation and at the same time to increases its revenues. No evident compromise is possible.

We suggest a simple strategy where the agents only take into account two parameters:

- Services select higher ranking of portals with higher reputation.
- Portals select services, which request a change in rating that would minimise the damage to their reputation.

As our dataset for the initial conditions for our simulation, we have chosen 15 mutual funds as services and four well-known keyword search portals, which provide ratings for these services by ordering them within search results page. We have simulated all phases of the subscription process, including the initial phase, when the services initiate the subscription process to modify their initial rating, and the terminal phase, when the services run out of resources and stop being selected by portals, or see no further benefit in participating in the process.

## A FORMAL MODEL

We use a matrix  $M$  to express ratings, where  $M(s,p)$  denotes the rating of service  $s$  by portal  $p$ . Ratings of services are represented by integers from 1 to  $ns$ , where the ratings are presented in ascending order from the highest rated service (1) to the lowest one ( $ns$ ). Each column of  $M$  contains integers  $1, \dots, ns$  in a certain order such that each integer occurs only once (i.e., a portal cannot assign the same rating to two services).

The average rating for a service,  $s$ , over the set of portals, is given by:

$$r_{avg}(s) = \sum_p \frac{M(s,p)}{\#p}$$

where  $\#p$  denotes the number of portals. Indeed, services intend to achieve better ratings from portals with higher reputation so the weighed  $M(s,p)$  comes into play (see next section).

The reputation for a portal is calculated as the reciprocal of the deviation of the rating it gives to each service from the average rating of the service, and is given by

$$reput(p) = \frac{1}{\sum_s |M(s,p) - r_{avg}(s)|}$$

Portal reputations are greater than zero: the higher  $reput(p)$ , the better the reputation is (i.e., the closer the totality of the given portal is to the average). If we assume that for a given portal its rating of every service is identical to the average rating, then the reputation of a portal approaches infinity. When choosing which portal to subscribe to, a service chooses the portal with the highest reputation while taking into account its possible increase in rating so that its rating will be as close to the highest rating (i.e., 1) as possible. More specifically, service,  $s$ , makes a subscription offer to portal,  $p$ , in such a way that

$$\frac{reput(p)}{M(s,p)}$$

is maximized.

Out of the totality of services, which make a subscription offer to a given portal, the portal selects the one, which would decrease its reputation the least. More specifically, portal  $p$  chooses to accept the subscription from the service  $s$  that minimizes

$$|M(s,p) - r_{avg}(s)|.$$

When portal,  $p$ , accepts the subscription offer from service,  $s$ , then  $s$  transfers  $m$  resource units to  $p$ , and  $p$  increases the ranking of  $s$  by one. So, if  $s$  was ranked at position  $n$  and  $s'$  was ranked at position  $n-1$ , their rankings are swapped. In the special case when  $s$  was already ranked at position 1, then the portal does not accept the offer from  $s$ .

The simulation that produced the results described in the next section was implemented in Matlab and is available from the first author on request.

## SIMULATION

We formed the initial dataset of ratings from a selected set of 15 mutual funds, rated by a set of four portals as a 4 by 15 matrix, where each column representing a portal contains numbers from 1 to 15 (without repetitions) denoting the ratings of the services by the portal.

For our simulations, we select four keyword-search companies as portals (Google, Altavista, Lycos, and Hotbot) and obtained their ratings of the 15 mutual funds as services

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