

# Google's Thriving Advertising Model Has Math Roots

## *Computer Scientists Optimize Online Ad Auction*

A 30-second prime-time television spot was once considered to be the most effective form of advertising, but search engine ads are replacing it. This year, predicts Advertising Age, the combined advertising revenues of Google and Yahoo! will rival the combined prime-time ad revenues of America's three big television networks, ABC, CBS and NBC. Now, researchers at the Georgia Institute of Technology and the University of California, Berkeley have discovered a computer algorithm that could further increase profits for search engine advertising.

"Our algorithm balances two trade-offs in a way that optimizes revenue in Google's advertising model," says Vijay Vazirani, professor in the College of Computing at Georgia Tech.

When Internet users perform a search on Google or Yahoo!, a separate list of advertising links appears to the right of each page of search results. Advertisers place bids for their ad links to appear with certain keywords, and the ads are ranked roughly in order of the amounts of the bids. (Search engines also take into account the popularity of the ad or "clickthrough rate.") An advertiser pays only when someone chooses to click on the ad link. On Google, advertisers can also specify a maximum daily budget for their ads. Once the budgeted amount is spent, an ad is dropped for the rest of the day.

Upon examining the Google ad model, Vijay Vazirani, together with his two Georgia Tech Ph.D. students, Aranyak Mehta and Amin Saberi, and Umesh Vazirani, a professor of computer science at Berkeley, realized that always giving the top spot to the highest bidder is not the best strategy for Google. The top bidders might rapidly exhaust their budgets and get dropped from the auction, thus reducing the competition for that keyword.

Google's profits will be higher, the researchers reasoned, if it somehow weighs both bids and remaining budget when ranking ads. They found a mathematical formula that finds the optimal trade-off between bids and remaining budget, maximizing what the advertisers are spending.

The research team has filed a provisional patent for their work to ensure that the research remains in the public domain. The team continues to explore other applications for their algorithm such as in engineering and for solving other computer science problems.

Source: Georgia Institute of Technology

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