Web Algorithms – Sponsored Search

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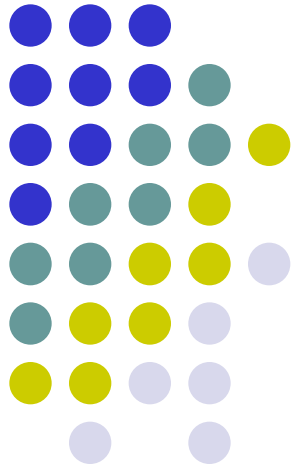
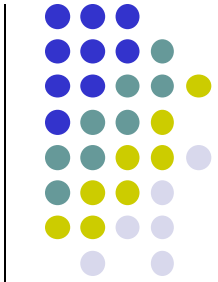


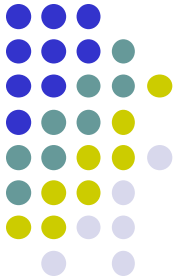
Overview



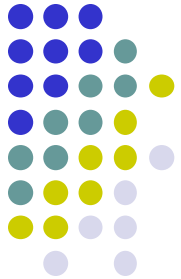
- Search and advertising
- Matching markets
- Auctions
- VCG mechanism
- GSP mechanism

Reference

David Easley and Jon Kleinberg
Networks, Crowds, and Markets
Cambridge University Press, 2010
ISBN: 9780521195331



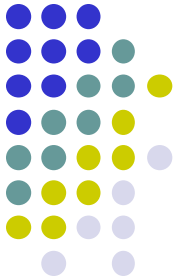
Search and Advertising



- Combining search and advertising: lucrative market!

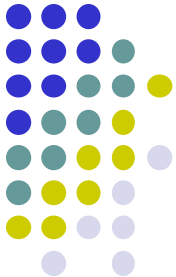
- Early advertising based on “impressions”:
  - The analogue of print ads in newspapers
  - Advertisers agreed on a price to show their ads (ex. Yahoo)

- Main drawback: not related to users interests (specified in queries)



Query or keyword-based advertising:

- Solution adopted today
- It creates a market out of users information-seeking behaviour
- Generates billion of dollars of revenue per year to search engines
- Nearly all of Google's revenue!
- Keyword-ads shown besides normal search results



Google keuka lake Search Advanced Search Preferences

Customized based on recent search activity. More details

Web Books Results 1 - 10 of about 381,000 for keuka lake [definition]. (0.19 seconds)

Welcome to The Keuka Lake Wine Trail
Information about seven wineries on **Keuka Lake** in the Finger Lakes district. Offers a trail map, event calendar, winery descriptions, tourist services, ...
www.keukawinetrail.com/ - 13k - Cached - Similar pages - Note this

A complete guide to the Keuka Lake Wine Country
your own, follow the **Keuka Lake** Wine Trail, or book a wine tour and leave the driving to a pro. From casual to gourmet, hotdogs to haute cuisine, ...
www.keukalake.com/ - 24k - Cached - Similar pages - Note this

Keuka Lake - Wikipedia, the free encyclopedia
Keuka Lake is an unusual member of the Finger Lakes because it is Y-shaped instead of long and narrow. Because of its shape, it was referred to in the past ...
en.wikipedia.org/wiki/Keuka_Lake - 26k - Cached - Similar pages - Note this

Seneca Lake (New York) - Wikipedia, the free encyclopedia
The two main inlets are Catharine Creek at the southern end and the **Keuka Lake** Outlet.

Sponsored Links

Keuka Lake Lodging
Lakeside vacation rentals on the Finger Lakes in upstate New York.
FingerLakesPremierProperties.com

Keuka Lake Real Estate
Looking for Information about **Keuka Lake** Real Estate?
www.MarkMalcolm.com
New York

Finger Lakes Real Estate
Find your dream home; Lakefront, Lakeview, Cottage, Land or Farm!
www.winetrailproperties.com
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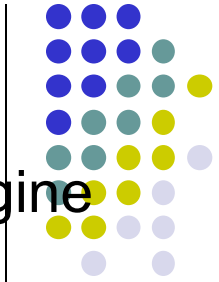
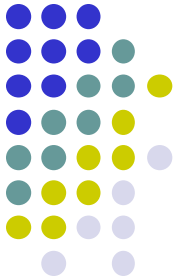


- Multiple paid results for a single query term: the search engine has sold an ad on the query to multiple advertisers
- Higher slots more expensive, since users click them at a higher rate
- Pay-per-click: advertisers pay for every click on their ad
- Clicking on ad represents a stronger indication of intent than simply issuing a query
- Thus, the amount advertisers are willing to pay is sometimes surprisingly high (about 50$ for “loan consolidation” or “mortgage refinancing”)

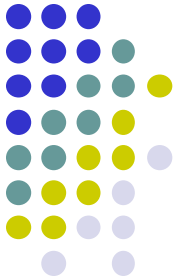


- Question: how to set prices per click?

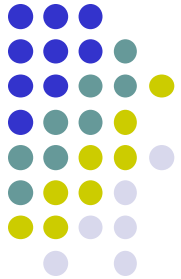
- Solution 1: post prices like in supermarkets
  - Unfeasible!
  - Too many keywords and combination of keywords
  - Hopeless for search engines to maintain reasonable prices for each possible query

- Solution 2: solicit offers from advertisers
  - The adopted solution
  - We are going to see two possible implementations:
    - Matching markets
    - Auctions

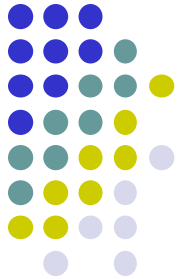
Advertising as a Matching Market



- Set of slots to place ads for each single query
- Slots numbered 1, 2, 3, … starting from top of the page
- r_i = clickthrough rate slot *i* (number of clicks per hour)
- v_j = revenue per click advertiser *j* (expected revenue per user who clicks on the ad)
- $r_1 \geq r_2 \geq r_3 \geq \ldots$: decreasing clickthrough rates, users more likely to click on higher slots
- $r_i \cdot v_j$: benefit advertiser *j* receives for being shown in slot *i*



clickthrough rates	slots	advertisers	revenues per click
10	a	x	3
5	b	y	2
2	c	z	1

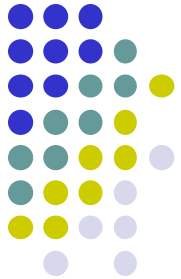


Simplifying assumptions:

1. Advertisers know clickthrough rates
2. The clickthrough rate depends only on the slot and not on the (relevance or quality of the) shown ad
3. The clickthrough rate also does not depend on the ads in the other slots
4. The revenue per click is intrinsic to the advertiser and does not depend on the page where the user clicked on the ad
5. Number of slots = number of advertisers

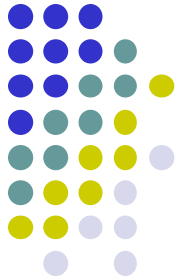
Remarks

- For 1. there are tools provided by the search engines
- 2., 3., and 4. are matter of current research
- For 5:
  - If more slots than advertisers, add advertisers with revenue *0*
  - If more advertisers than slots, add slots with clickthrough rate *0*



- The allocation of slots to advertisers can be modelled as a matching market

- Matching market:
  - Set of buyers (advertisers) and set of slots (sellers)
  - Each buyer *j* has a valuation $v_{i,j}$ for the item offered by seller *i*
  - Goal: properly match up buyers and sellers



- In our setting:
  - slots ≡ sellers
  - advertisers ≡ buyers
  - valuations $v_{i,j} = r_i \cdot v_j$
- Let's see then matching markets in more detail