Auctions

advertising auctions

VCG

Advertising – how it used to be

Pay-per-impression

Price depends on how many people your advertisement is shown to.

(whether or not they look at it, or care about it)

"Half the money I spend on advertising is wasted; the trouble is, I don't know which half"

Andrew Wanamaker, advertising pioneer

Sponsored Search Ads

Pay per click.

Google mesothelioma

All News Images Videos Books More Settings Tools SafeSea

About 7,290,000 results (0.61 seconds)

Ad · www.nationalmesotheliomaclaims.com/

Mesothelioma Claim Center | Get Asbestos Cancer Payments

Learn how the $30B Asbestos Trust Fund may pay for your asbestos-caused cancer.

Mesothelioma Claims
Asbestos Trust Fund Claims
This $30 Billion Trust Can Help

Free Info Package
Covers what you need to know
about medical and financial options

Ad · www.mesotheliomabook.com/ (888) 637-6234

Family Hurt by Mesothelioma? | We're Here to Help You

We are the largest firm devoted only to **Mesothelioma** in the US, visit us today. We come to...

Ad · www.mesothelioma-survivor.com/mesothelioma/treatment (800) 336-0086

I Survived Mesothelioma Cancer - Learn How She Beat the Odds

Learn About Heather's Successful Surgery from Preparation to the Procedure & Recovery.

Ad · www.navy-veterans-mesothelioma.org/Financial/Benefits

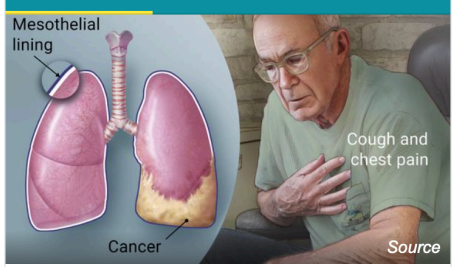
Mesothelioma & Asbestos Risk | Navy Vets Asbestos Claims

Important info for Navy Vets. Learn About **Mesothelioma** Claims

Mesothelioma is a type of cancer that develops from the thin layer of tissue that covers many of the internal organs (known as the mesothelium). The most

Mesothelioma

ABOUT SYMPTOMS TREATMENTS



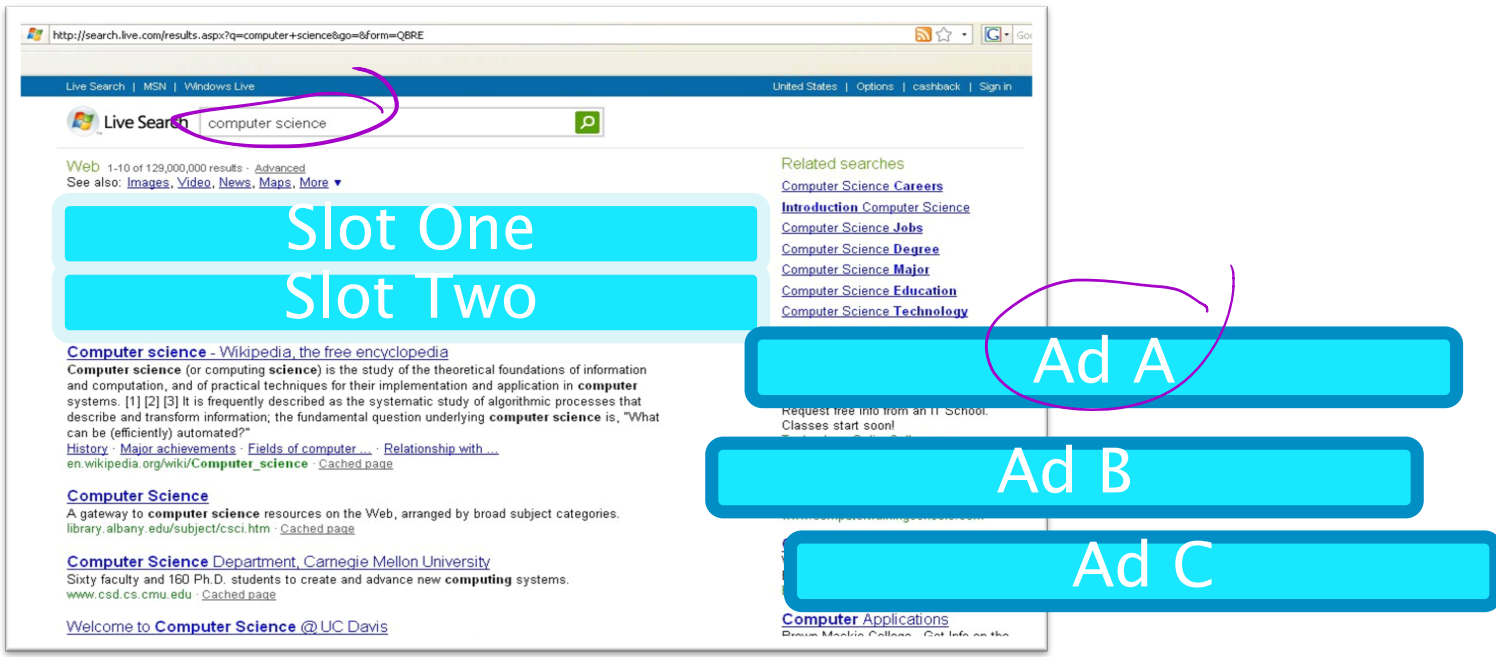
A tumor of the tissue that lines the lungs, stomach, heart, and other organs.

Very rare

Fewer than 20,000 US cases per year

- Treatment can help, but this condition can't be cured
- Requires a medical diagnosis
- Lab tests or imaging always required

Price determined by auction – per keyword



"Most people don't realize that all that money comes in pennies at a time" Hal Varian, Google Chief Economist

Switch to auctions/PPC watershed

- Allows advertiser to much more finely target customers.
  - Customer did a search on related topic
  - Customer then bothered to click on the ad.
- Reduces risk to advertisers.
- Provides advertisers with very accurate metrics.
  - Was the ad clicked on?
  - Did the click result in a purchase?
- Nobody is getting locked into long-term constracts.
- Users are happier because the ads they are being shown are higher quality and better tailored to their needs.

Model

- goods for sale are k slots for sponsored links on searchpage
- bidders advertisers currently have standing bid on relevant keywords.

- slots not identical
- quantify difference using "clickthru rates" CTR.
- $c_1 > c_2 > \cdots > c_k$
  - c_i = Prob of a click on an ad in slot i.
  - q_j = "quality" of advertiser j. for now $q_j = 1$

  (put ad j in slot i Prob of a click $c_i q_j$)
- each advertiser j has expected value v_j for a click on their ad.
- expected value adv j gets if his ad → slot i $c_i v_j$

  if payment p_j/click.

  exp payment $c_i v_j - c_i p_j$

Generalized 2nd Price Auction (GSP)

Collect bids from advertisers

allocate highest bidder → slot 1
2nd → slot 2
⋮

$b_1 > b_2 \cdots b_k > b_n$

$p_i = b_{i+1}$

PPC

Prior to intro GSP. were using pay your bid.
- automated bidding agents
- constant bid updating.

Example – GSP not truthful

Click-through rates

$c_1 = 1$ (1)

$c_2 = 0.9$ (2)

0 No slot

Slots

Value per click

A 10 $= v_1$

B 9 $= v_2$

C 0.01 $= v_3$

Advertisers

exp utility

$c_1 v_1 - c_1 p_1 = 1$

$c_2 v_2 - c_2 p_2$

$0.9 \cdot 9 - 0.9 \cdot 0.01$

$b_1 = 5$

$c_2 v_1 - c_2 \cdot 0.01$

$0.9 \cdot 10 - 0.9 \cdot 0.01$

$9 - \ldots$

Benefit to overbidding?

$c_i v_j - c_i b$

next b

Fix other bids.

suppose agent j bids

$b_j > v_j$

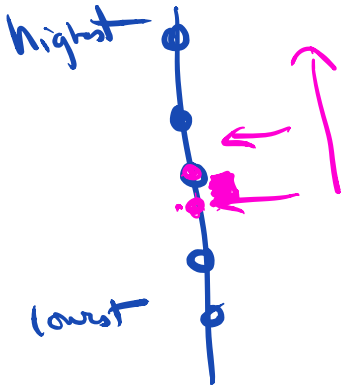
slot

$c_i v_j - c_i b$

next highest below b_j

$b \geq v_j$

$b < v_j$



In this model, is there an auction that
- maximizes social welfare
- individually rational
- truthful.

$v_1 > v_2 > \dots > v_n$ $\quad c_1 > c_2 > c_3 \dots > c_k$ $\quad c_{k+1} = 0$.

b_1 b_2 b_n

What allocation maximizes SW?

$v_i \to c_i$

get SW $\quad \sum_{i=1}^{k} v_i c_i$

$\sum_i$ (utilities of bidders) (utility of auctioneer)

$= \sum_i$ exp value to i of alloc received.

$j \to$ slot $s(j)$

$c_{s(j)} v_j$

charge each bidder their "externality"

externality: cost or benefit to others due to my behavior/existence

Fix bidder 1:

with bidder 1 present, SW of others is $\sum_{i=2}^{k} v_i c_i$

with bidder 1 absent, SW of others is $\sum_{i=2}^{k+1} v_i c_{i-1}$

Bidder 1's externality $= \sum_{i=2}^{k+1} (c_{i-1} - c_i) v_i$

this is what we will change bidder i (exp payment)

Bidder i's externality (exp payment) $= \sum_{j=i}^{k+1} (c_{j-1} - c_j) v_j$

VCG auction for sponsored search

Ask each bidder for bid.

assign bidder $i \to$ slot i

VCG payment per click PPC

$$p_i = \frac{1}{c_i} \sum_{j=i+1}^{k+1} b_j (c_{j-1} - c_j)$$

$b_1 > b_2 > \dots > b_n$

GSP

$p_i := b_{i+1}$

$b_3 \leftarrow$

$k = 4$

$i = 2$

$$b_3 \frac{(c_2 - c_3)}{c_2} + b_4 \frac{(c_3 - c_4)}{c_2} + b_5 \frac{(c_4 - c_5)}{c_2}$$

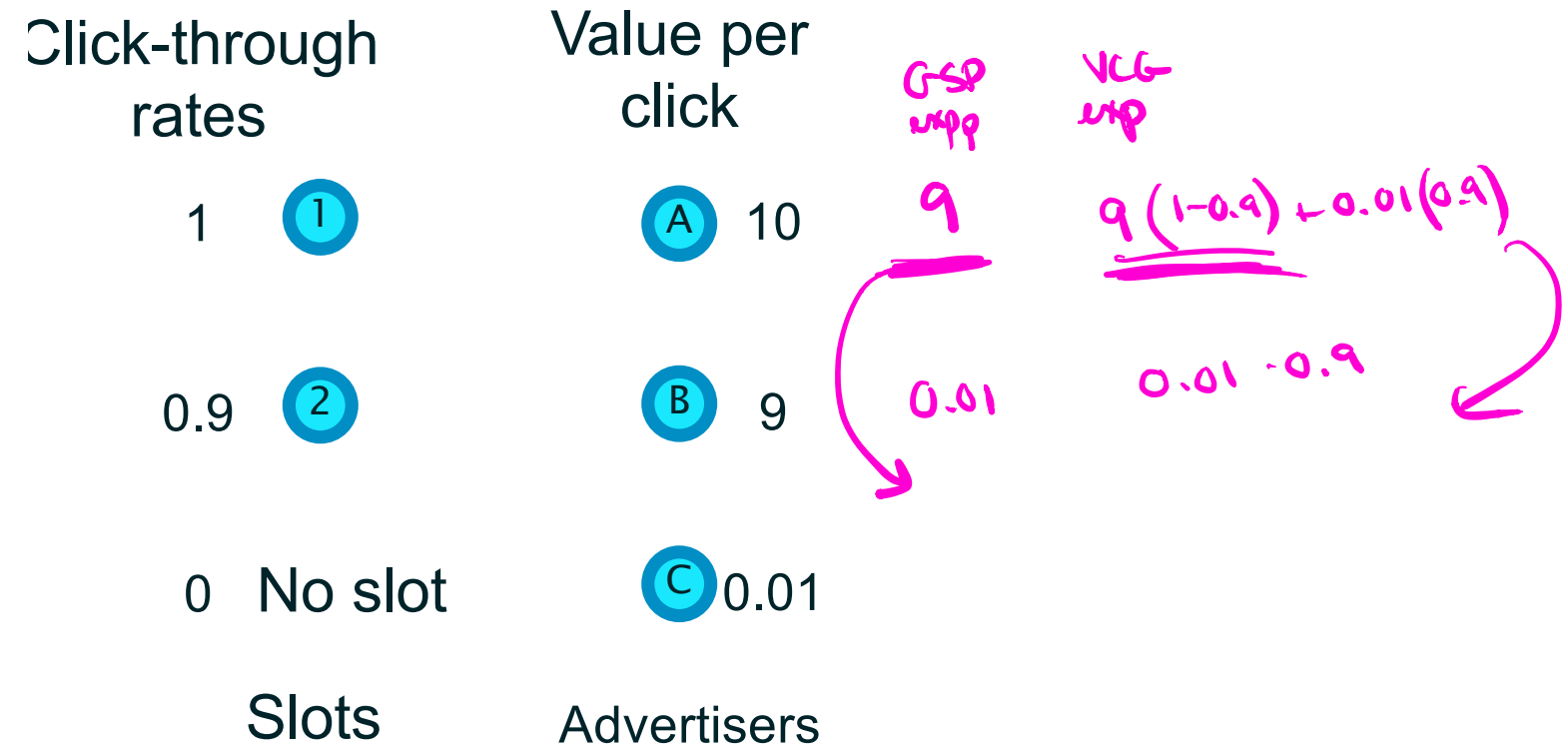
convex comb.

$w = \lambda_1 v_1 + \lambda_2 v_2 + \dots + \lambda_k v_k$

$\sum \lambda_i = 1$

$\lambda_i \geq 0$

Same example with VCG



GSP has been the dominant paradigm in sponsored search auctions.

possible that revenue from GSP > rev from VCG.

No direct revenue comparison that you can make.

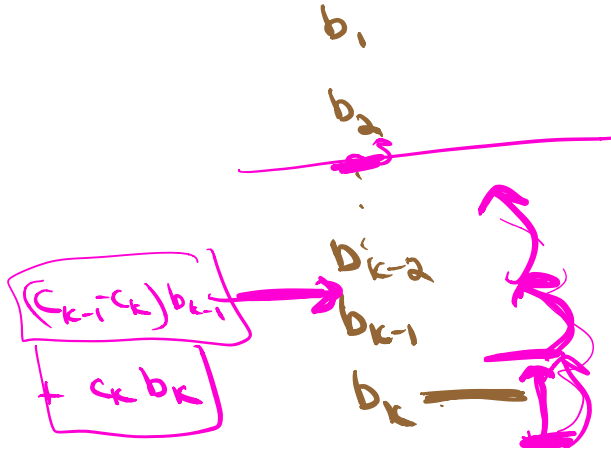
$\exists$ Nash eq in GSP that results in same allocation & payments as in (truthful) VCG

many other eq too.

$$c_i p_i = \sum_{j=i+1}^{k+1} (c_{j-1} - c_j) b_j$$

Thm VCG is truthful.

Pf Fix bidder i w/ value v, Fix bids of all other bidders.



Δ value $= (c_{k-1} - c_k) v$

Δ pay $= (c_{k-1} - c_k) b_{k-1}$

Δ exp value $= c_k v$

Δ payment $= c_k b_k$

Google

relevant ads determined by query

"fixed" ordering of slots

"fixed" # of slots

advertisers bidding on clicks

Facebook

your friends activity in your newsfeed.

ads different sizes & formats.

clicks
likes
downloads of app.

many more possible outcomes to match
- dynamic resizing.

very difficult for advertisers to estimate CTRs.

in VCG, advertisers don't need to know CTRs (seller has a lot more info about CTRs)

FB

advertisers can bid on "events" clicks, likes, app downloads,

much more general model than sponsored search auction model.

VCG: n bidders

Ω - finite set of outcomes.

each agent i has value $v_i(\omega)$ $\forall \omega \in \Omega$

VCG is truthful mech for choosing outcome $\omega^* \in \Omega$

such that $\sum_{i=1}^{n} v_i(w^*)$ is maximized.

$$p_i = \max_{w} \sum_{j \neq i} b_j(w) - \sum_{j \neq i} b_j(w^*)$$

$v_j(b_j)$