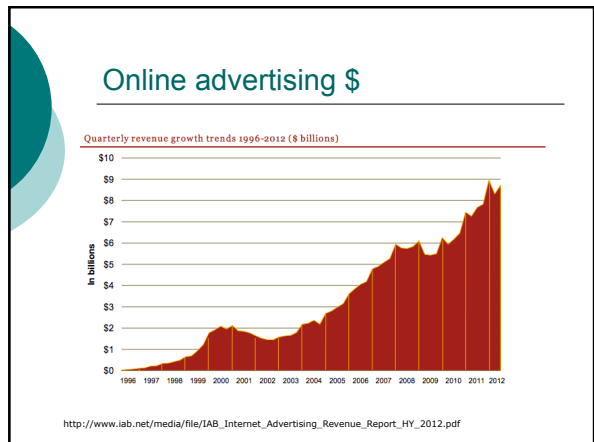


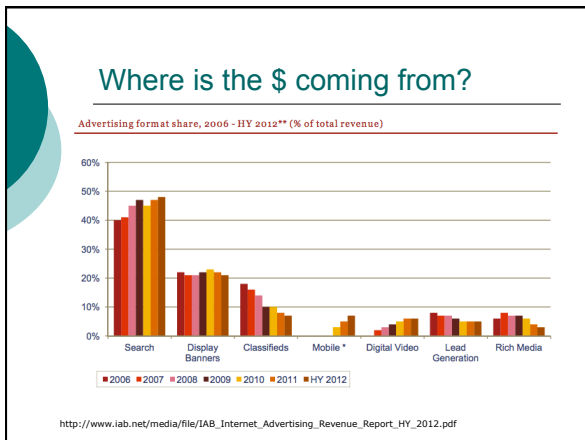
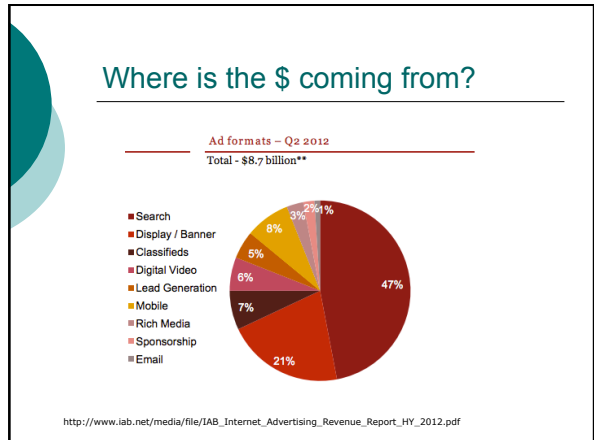
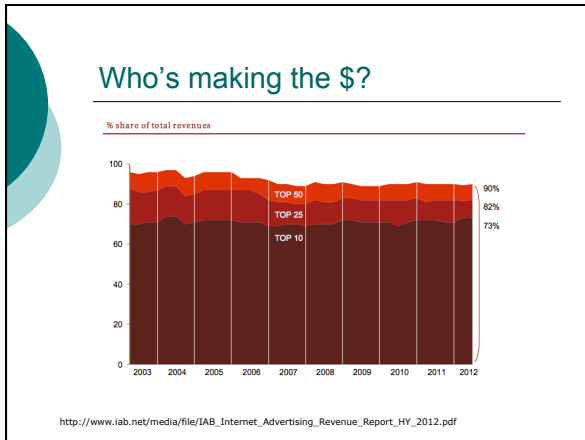
Online Advertising

David Kauchak
cs458
Fall 2012

Administrative

- Papers due tomorrow
- Review assignments out Saturday morning
 - Review due Sunday
- Project presentations next Friday, 7-10pm
 - shoot for 15-20 min





3 major types of online ads

Banner ads

Keyword linked ads

Context linked ads

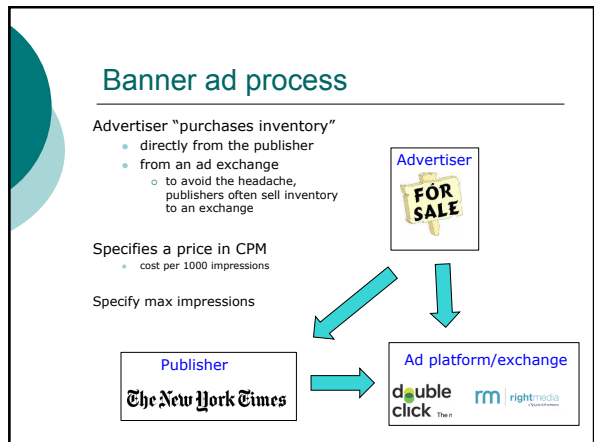
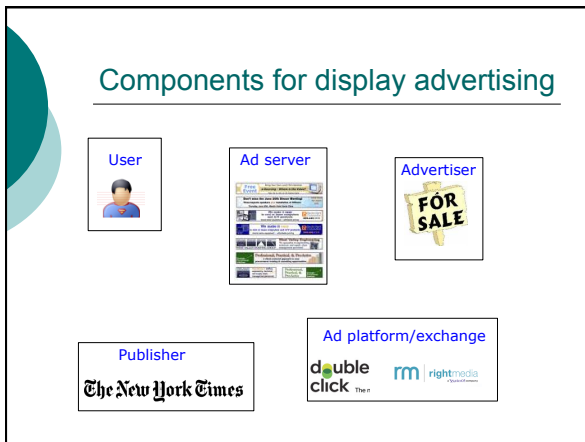
Banner ads

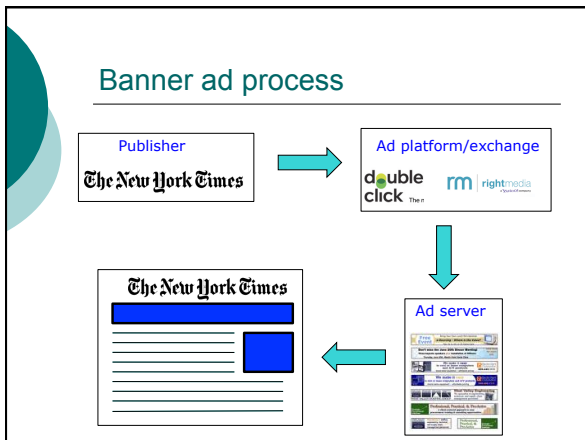
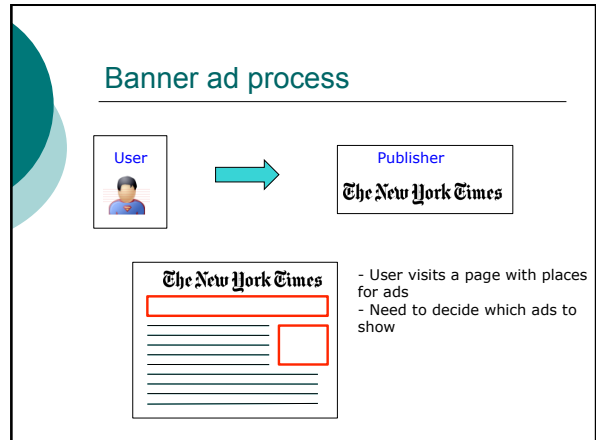
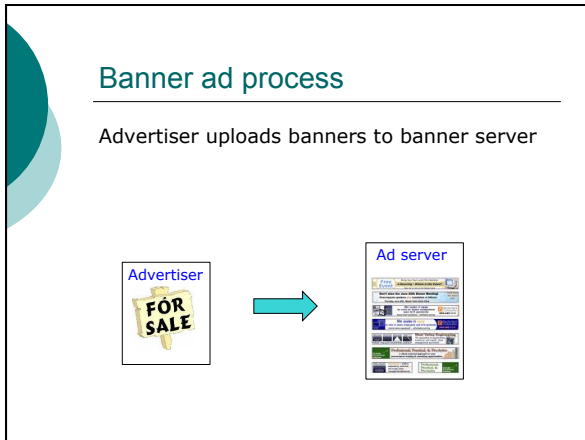
standardized set of sizes

Ad formats

- Floating ad: An ad which moves across the user's screen or floats above the content.
- Expanding ad: An ad which changes size and which may alter the contents of the webpage.
- Polite ad: A method by which a large ad will be downloaded in smaller pieces to minimize the disruption of the content being viewed
- Wallpaper ad: An ad which changes the background of the page being viewed.
- Trick banner: A banner ad that looks like a dialog box with buttons. It simulates an error message or an alert.
- Pop-up: A new window which opens in front of the current one, displaying an advertisement, or entire webpage.
- Pop-under: Similar to a Pop-Up except that the window is loaded or sent behind the current window so that the user does not see it until they close one or more active windows.
- Video ad: similar to a banner ad, except that instead of a static or animated image, actual moving video clips are displayed.
- Map ad: text or graphics linked from, and appearing in or over, a location on an electronic map such as on Google Maps.
- Mobile ad: an SMS text or multi-media message sent to a cell phone.

<http://people.ischool.berkeley.edu/~hal/Courses/StratTech09/Lectures/Advertising/online-advertising.ppt>





What are the problems/ inefficiencies with this process?

Pricing

- Fairly static: difficult to change price regularly
- variable pricing based on user, etc
- cpm pricing doesn't take into account clicks, revenue, etc.


User targeting

- We're only targeting users based on the site/page visited
- What about a user that visits the same page everyday (e.g. nytimes)?

Banner creation is fairly static

- situation specific banners

Current trends: user targeting



What information might we know about a user?

- many of the sites a user has visited
 - cookies
 - everytime an ad is shown to a user, the ad is requested and we know which site the user is at
 - e.g. doubleclick cookie
- Which ads the user has seen
- Which ads the user has clicked on
- Geographic information (via IP)
- Demographic information (age, gender, profession, ...)
 - Signed in to Yahoo, Hotmail, etc.
- Day of week, time of day, part of the month
- Lots of other information
 - How much money they make
 - Whether they've bought anything recently
 - Mortgage payment
 - Habits, etc.

User targeting: RealAge

Calculate your "biological age" based on a questionnaire

150 questions

27 million people have taken the test

Information is used for marketing purposes


Health Interests
Choose the topics below that interest you and your family.

<p>Medical Conditions</p> <ul style="list-style-type: none"> <input type="checkbox"/> ADD/ADHD, adult <input type="checkbox"/> ADD/ADHD, child <input type="checkbox"/> Allergies <input type="checkbox"/> Arthritis, joint pain <input type="checkbox"/> Asthma, adult <input type="checkbox"/> Asthma, child <input type="checkbox"/> Back pain <input type="checkbox"/> Cancer <input type="checkbox"/> Chronic pain <input type="checkbox"/> Diabetes, type 2 <input type="checkbox"/> Diabetes, type 1 <input type="checkbox"/> Edema <input type="checkbox"/> Gastrointestinal conditions <input type="checkbox"/> Headaches, migraines <input type="checkbox"/> Heartburn <input type="checkbox"/> Insomnia, sleep problems <input type="checkbox"/> Osteoporosis, bone health <p>Women's Health</p> <ul style="list-style-type: none"> <input type="checkbox"/> Breast cancer <input type="checkbox"/> Incontinence and overactive bladder <input type="checkbox"/> Menopause <input type="checkbox"/> Period problems <input type="checkbox"/> Sexual health <p>Men's Health</p> <ul style="list-style-type: none"> <input type="checkbox"/> Prostate health <input type="checkbox"/> Sexual health <input type="checkbox"/> Hair loss <p>Cardiovascular Conditions</p> <ul style="list-style-type: none"> <input type="checkbox"/> Heart disease <input type="checkbox"/> High blood pressure <input type="checkbox"/> High cholesterol 	<p>Lifestyle</p> <ul style="list-style-type: none"> <input type="checkbox"/> Fitness and exercise <input type="checkbox"/> Food and nutrition <input type="checkbox"/> Healthy home <input type="checkbox"/> Herbs and alternative medicine <input type="checkbox"/> Living green <input type="checkbox"/> Longevity and retirement <input type="checkbox"/> Looking younger <input type="checkbox"/> Traveling <input type="checkbox"/> Reducing financial stress <input type="checkbox"/> Reducing personal stress <input type="checkbox"/> Weight management <p>Memory and Emotional Health</p> <ul style="list-style-type: none"> <input type="checkbox"/> Anxiety <input type="checkbox"/> Bipolar disorder <input type="checkbox"/> Depression <input type="checkbox"/> Memory and mind <p>General Body Maintenance</p> <ul style="list-style-type: none"> <input type="checkbox"/> Dental care <input type="checkbox"/> Foot care <input type="checkbox"/> Healthy hair <input type="checkbox"/> Hearing, ear care <input type="checkbox"/> Skin care <input type="checkbox"/> Vision, eye health
---	--


User targeting: data aggregation

Companies aggregate this data

- Bluekai
- Excelate



User targeting: Social networking sites


Sites like myspace and facebook have lots of information about users, users' friends, etc

- use content on a user's page
- use information about a user's friends, e.g. purchases

User targeting: bottom line

On a per impression basis, we have lots of information about the user the ad will be shown to

User



- age
- gender
- location
- income
- search history
- number of ad views
- ...

Banner ad pricing

Advertising exchange

- Auction-based system for purchasing ads
- Auction happens roughly per impression
- Auction targeting based on user characteristics
- recent trend (last year or two)

\$3 CPM for men, ages 20-25, CA NY FL from 12-5pm

Banner ad exchanges


Advertiser "uploads" bids to exchange

- via spreadsheet
- or programmatically
- Specify targeting
- Can also set thresholds on user views

Auction is performed by exchange


Downsides?

Advertiser




→

Ad platform/exchange



Ideal ad exchange: true auction

User




→

Publisher


The New York Times

Advertiser



←

Ad platform/exchange



→

bid(\$)

age
gender
location
income
search history
number of ad views
...

True auction: technical challenges

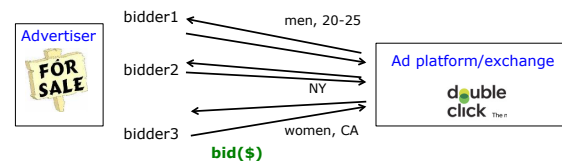
We need to make a decision quickly (on the order of a few hundred ms)

- multiple advertisers
- advertiser must make decision
- network latency
- perform auction
- this happens millions of times a day
- ...

True auction: some first attempts

DoubleClick "callback"

- specify a "bidder" based on some targeting specifications
- bidder only bids on impressions that match criterion



True auction: AppNexus

Ex-RightMedia folks

Initially, cloud computing

Advertiser runs a bidder server side

- avoid network latency
- auction is self-contained at the exchange
- Requires framework on exchange side for security, speed, etc.

Pricing

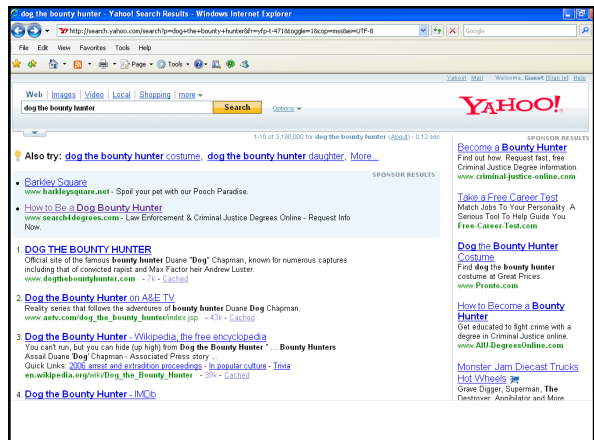
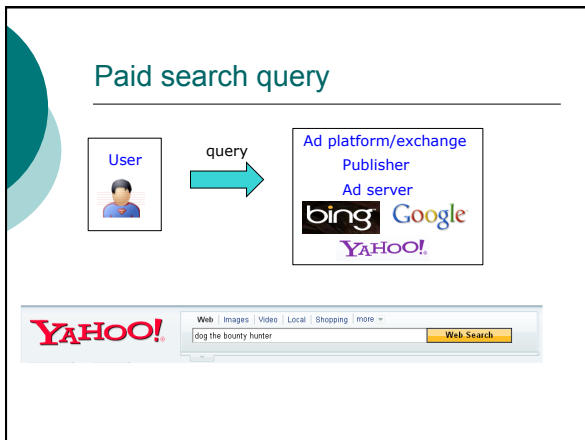
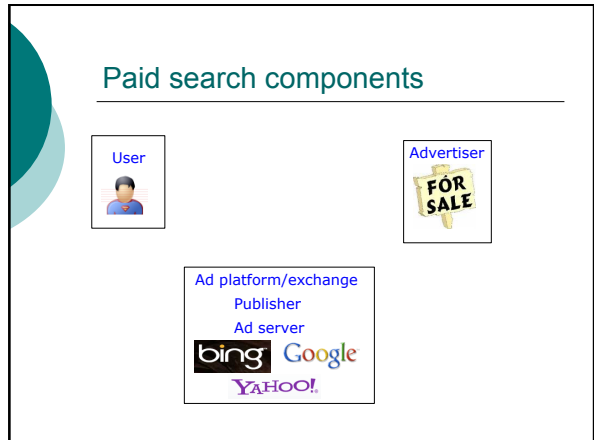
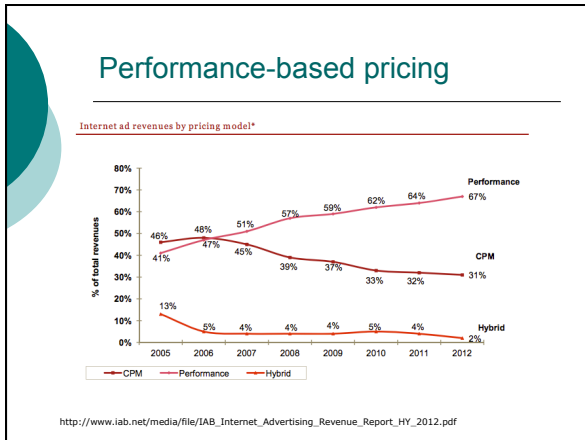
Advertisers don't care about CPM

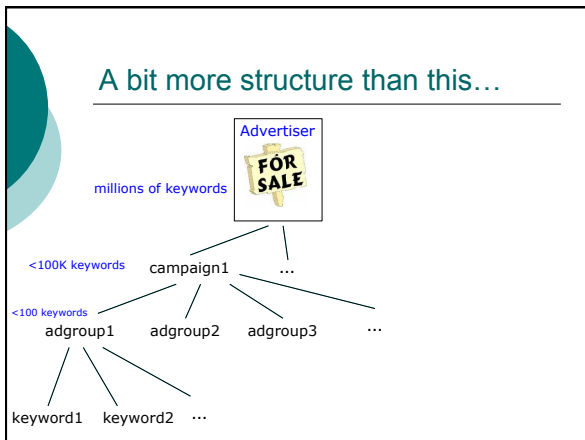
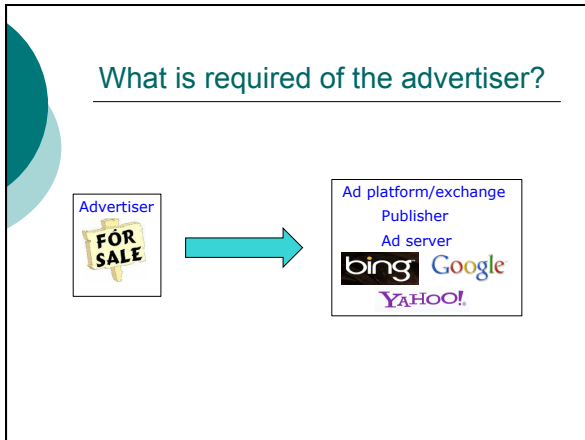
- CPC (cost per click)
- CPA (cost per action)
- RPM (revenue per impression)

Some work to move exchanges towards this

Challenge?

- Need to estimate these from data
- Data is very sparse ~1/1000 people click
- Similar order of magnitude for purchases (though depends on the space)





Adgroups

Adgroups are the key structure

Adcopy and landing pages are associated at the Adcopy level

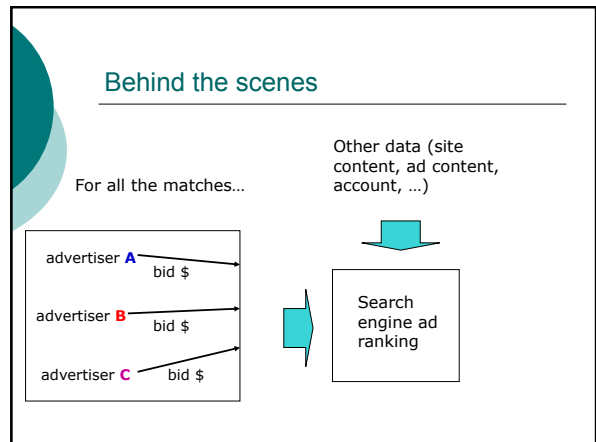
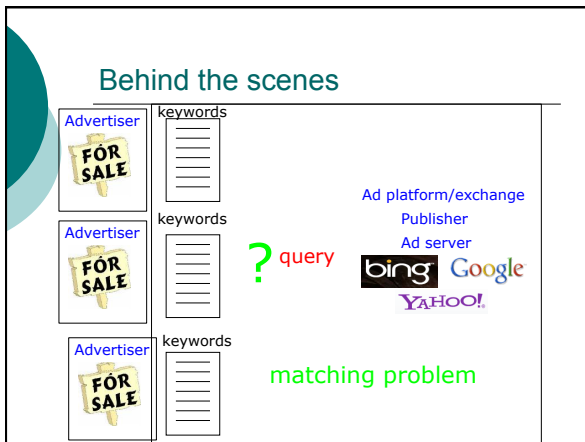
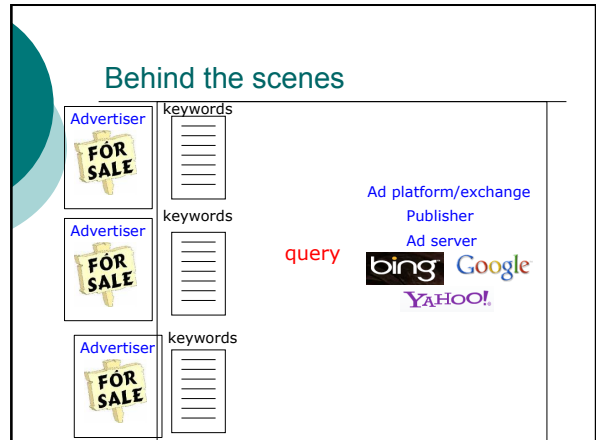
Keywords should be tightly themed

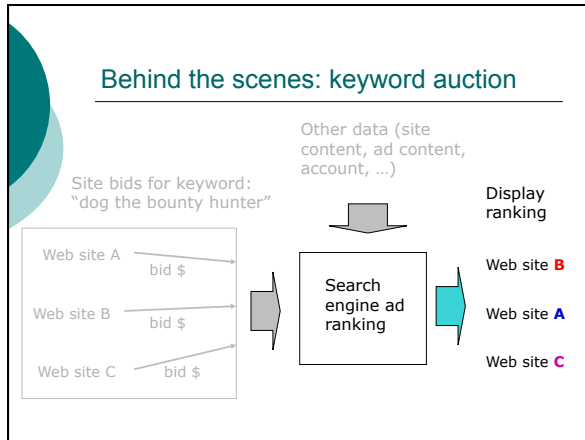
- promotes targeting
- makes google, yahoo, etc. happy

Creating an AdWords Ad

Feb-14, 2003 to Jan-26, 2006

Advertiser	Status	Current Bid	Clicks	Imps	CTR	Adm. Cost	Cost	Adm. Fee
Total	Paused	\$1.00	496	22,964	1.99%	\$0.46	\$391.27	3.0
seattle.seawall	Active	\$1.00	126	5,034	2.21%	\$0.30	\$27.26	1.1
seattle.condo	Active	\$1.00	143	2,966	4.82%	\$0.43	\$61.89	1.2
seattle.condominium	Active	\$1.00	50	1,296	3.86%	\$0.33	\$16.54	1.3
seattle.hotel.apartment	Active	\$1.00	2	79	2.52%	\$0.26	\$0.12	1.1
seattle.hotel.apartment	Active	\$1.00	1	63	1.59%	\$0.01	\$0.01	4.0
seattle.hotel.condo	Active	\$1.00	2	47	4.26%	\$0.28	\$0.57	1.2
seattle.luxury.apartment	Active	\$1.00	2	34	0.33%	\$0.09	\$0.17	1.1
seattle.hotel.house	Active	\$1.00	1	22	4.54%	\$0.54	\$0.54	1.9
seattle.luxury.condo	Active	\$1.00	4	19	21.05%	\$0.05	\$2.19	1.6
seattle.luxury.condominium	Active	\$1.00	1	7	14.29%	\$0.10	\$0.10	2.0





Search ad ranking

Bids are CPC (cost per click)... though they weren't always...

How do you think Google determines ad ranking?

$$\text{score} = \text{CPC} * \text{CTR} * \text{"quality score"} * \text{randomness}$$

cost/clicks * clicks/impression = cost/impression

Is it a good web pages?
Good adcopy?
Adcopy related to keyword?

Enhances user experience, promoting return users

don't want people reverse engineering the system
data gathering

1st price auction

Each bidder pays what they bid

Not used by search engines. Why?

Don't work well for repeat auctions!

Bidder	value	Bid1
A	9	10
B	7	5

How would the bids change next time (assuming a blind auction)?

1st price auction

Each bidder pays what they bid

Not used by search engines. Why?

Don't work well for repeat auctions!

Bidder	value	Bid1	Bid2
A	9	10	7
B	7	5	6

A is going to want to decrease it's bid

B increase

1st price auction

Each bidder pays what they bid

Not used by search engines. *Why?*

Don't work well for repeat auctions!

Bidder	value	Bid1	Bid2	Bid3
A	9	10	7	6
B	7	5	6	7

A decrease

B increase

1st price auction

Each bidder pays what they bid

Not used by search engines. *Why?*

Don't work well for repeat auctions!

Bidder	value	Bid1	Bid2	Bid3	Bid4
A	9	10	7	6	8
B	7	5	6	7	7

1st price auction

Each bidder pays what they bid

Not used by search engines. *Why?*

Don't work well for repeat auctions!

Bidder	value	Bid1	Bid2	Bid3	Bid4	Bid5
A	9	10	7	6	8	8
B	7	5	6	7	7	5


1st price auction

Each bidder pays what they bid

Not used by search engines. *Why?*

Don't work well for repeat auctions!

In general, tend to end up with unstable bids in a "sawtooth" pattern



- bid down when you're winning
- bid up to get back in first
- bid back down

Auction system

2nd price auction (Vickrey auction)

- Winner pays one penny more than the 2nd place bid
- Slightly complicated by modified scoring
- Avoids sawtooth problem, but still not perfect

Bidder	Bid	Bidder	Price
A	10	A	5.01
B	5	B	1.01
C	1	C	1

CTR with respect to position

Position in SERPs	Percentage of Total Clickthroughs
1	42.30%
2	11.52%
3	8.44%
4	6.02%
5	4.88%
6	3.88%
7	3.07%
8	2.49%
9	2.09%
10	1.68%
11	1.36%
12	1.08%
13	0.84%
14	0.67%
15	0.53%
16	0.41%
17	0.32%
18	0.25%
19	0.20%
20	0.16%

Note, these are not CTRs, but relative CTRs

<http://www.seo-blog.com/serps-position-and-clickthroughs.php>

Predicted CTR

score = CPC * CTR * "quality score" * randomness

Any problem with using CTR of a keyword?

- Zipf's law: most keywords get very little traffic
- CTRs are generally ~1-3%
- Need a lot of impressions to accurately predict CTR
- New advertisers, new adcopy, ...

Major prediction task

- machine learning
- lots of features
- share data within an advertiser and across advertisers

Factors affecting revenue for search engine

Monetization (RPM) = $\frac{\text{Revenue}}{\text{Queries}}$

= $\frac{\text{Revenue}}{\text{Clicks}} \times \frac{\text{Clicks}}{\text{Queries}}$

= $\frac{\text{Revenue}}{\text{Clicks}} \times \frac{\text{Queries w/ Ads}}{\text{Queries}} \times \frac{\text{Ads}}{\text{Queries w/ Ads}} \times \frac{\text{Clicks}}{\text{Ads}}$

= $\underbrace{\text{CPC}}_{\text{Price}} \times \underbrace{\text{Coverage} \times \text{Depth}}_{\text{Quantity}} \times \underbrace{\text{CTR per Ad}}_{\text{Quality}}$

<http://people.ischool.berkeley.edu/~hal/Courses/StratTech09/Lectures/Advertising/online-advertising.ppt>

Increasing search engine revenue

- Increase CPC (cost per click)**
 - Increase conversion rate (i.e. post click performance)
 - Increase competition (higher bids)
- Increase coverage and depth**
 - More keywords
 - more keywords per advertiser (i.e. keyword tools)
 - more advertisers
 - More broadly matching keywords to queries
- Increase CTR (click through rate)**
 - Show more relevant ads in higher positions
 - Encourage high quality ads
 - Precise keyword/query matching

Advertiser margin

margin = revenue - cost

$$= \frac{\text{Revenue}}{\text{Action}} \times \frac{\text{Actions}}{\text{Impression}} \times \text{Impressions} - \text{COST}$$

$$= \frac{\text{Revenue}}{\text{Action}} \times \frac{\text{Actions}}{\text{Click}} \times \frac{\text{Clicks}}{\text{Impression}} \times \text{Impressions} - \text{COST}$$

$$= \frac{\text{Revenue}}{\text{Action}} \times \frac{\text{Actions}}{\text{Click}} \times \frac{\text{Clicks}}{\text{Impression}} \times \text{Impressions} - \frac{\text{Cost}}{\text{Click}}$$

revenue per transaction
conversion rate
CTR
CPC

Increasing advertiser margin

- Increase revenue per transaction**
 - sales, marketing
 - increase price
- Increase conversion rate (actions per click)**
 - better landing page
 - better offers
 - cheaper price
 - more offers/options
- Increase click through rate**
 - better adcopy
- Increase impressions**
 - more keywords
- Decrease cost per click**
 - decrease bid
 - increase "quality score"
 - bid on less competitive keywords

Contextual advertising

Contextual Advertising

Text ads on web pages

Uses similar technology and framework to search advertising

- Advertiser supplies keywords, adgroups, adcopy, bids
- Rather than match queries, match text on page

Some differences

- A lot more text, so many more matches and multiple matches
- Generally lower CTRs, lower conversion performance, adjustments made in payment

Easy way for search engines to expand revenue

Challenges

- extracting "keywords" from a web page
- be careful about matching. e.g. wouldn't want to show a competitors ad

How the ads are served

```
function google_show_ad() {
  var w = window;
  w.google_ad_url = 'http://pagead2.googlesyndication.com/pagead/ads?' +
    '&url=' + escape(w.google_page_url) +
    '&hl=' + w.google_language;
  document.write('<iframe' + 'ame' +
    'width=' + w.google_ad_width +
    'height=' + w.google_ad_height +
    'scrolling=no></ifr' + 'ame>');
}
google_show_ad();
```

<http://people.ischool.berkeley.edu/~hal/Courses/StratTech09/Lectures/Advertising/online-advertising.ppt>

Lots of problems in online advertising

Display (banner ads)

- Banners on the fly
- User targeting
 - Predict performance based on user data
 - Tracking users
- auctions
 - buyer strategy
 - auction holder policies
- Banner/ad selection

Lots of problems in online advertising

Paid search

- keyword generation
- adgroup generation
- keyword performance estimation
 - impressions/volume, CTR, conversion rate, rev.
- adcopy generation
- bid management
- auction mechanisms
- keyword/query matching

Lots of problems

Misc

- Data analysis
 - What works well
 - Trends in the data
 - Anomalies
- click fraud
- scale (many of these things must happen fast!)
- Landing page optimization

Typical CPMs in advertising

- Outdoor: \$1-5 CPM
- Cable TV: \$5-8 CPM
- Radio: \$8 CPM
- Online
 - Display \$5-30 CPM
 - Contextual: \$1-\$5 CPM
 - **Search: \$1 to \$200 CPM**
- Network/Local TV: \$20 CPM
- Magazine: \$10-30 CPM
- Newspaper: \$30-35 CPM
- Direct Mail: \$250 CPM

<http://people.ischool.berkeley.edu/~hal/Courses/StratTech09/Lectures/Advertising/online-advertising.ppt>