CMSC 474, Introduction to Game Theory

Online Advertisement Auctions

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AdWord Auction
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- Internet search companies such as Google, Yahoo, and MSN make billions of dollars out of it
- They decide what ads to display with each query to maximize revenue
- Users typing in query keywords, called AdWords
- Business place bids for individual AdWords together with a daily budget limit
- Search engines earn money from business when they show their ads in response to queries and charge them the second highest bid
Google AdWords

Advertise your business on Google

No matter what your budget, you can display your ads on Google and our advertising network. Pay only if people click your ads.

Benefits of AdWords

- **Effective:** Advertise on the most-used search engine worldwide.
- **Local:** Choose to show your ads in your region only.
- **Quick:** Set up your ad yourself or call us for free first-time set-up service.
- **Easy:** No expertise required.
- **Measurable:** Reports show you what you get for your money.
- **No risk:** You only pay when your advertising works.
- **Flexible:** Change, pause or end your campaign at any time.
Online AdWord Auction

- When page arrives, assign an eligible ad.
  - revenue from assigning page $i$ to ad $a$: $b_{ia}$
- “AdWords” (AW) problem:
  - Maximize revenue of ads served: $\max \sum_{i,a} b_{ia} x_{ia}$
  - Budget of ad $a$: $\sum_{i \in A(a)} b_{ia} x_{ia} \leq B_a$
Display Ad Auction
Display Ad Auction

- **Impression**: Display/Banner Ads, Video Ads, Text Links
- **Cost-Per-Impression (CMI/CPM)**
- **Done through offline negotiations+ Online allocations**
- **Q1, 2010**: One Trillion Display Ads in US, $2.7 Billion
- **Top publisher**: Facebook, Yahoo and Microsoft sites
- **Top Advertisers**: AT&T, Verizon, Scottrade
- **Ad Serving Systems** e.g., Facebook, Google DoubleClick Ad Planner
DoubleClick Ad Planner

Which websites attract your target customers?

View a site listing: Enter a site URL

Ad Planner top 1,000 sites

Refine your online advertising with DoubleClick Ad Planner, a free media planning tool that can help you:

Identify websites your target customers are likely to visit

- Define audiences by demographics and interests.
- Search for websites relevant to your target audience.
- Access unique users, page views, and other data for millions of websites from over 40 countries.

Easily build media plans for yourself or your clients

- Create lists of websites where you'd like to advertise.
- Generate aggregated website statistics for your media plan.

Are you a publisher?
Showcase your site with the DoubleClick Ad Planner Publisher Center.

Learn more about DoubleClick Ad Planner

How it works

Define your audience

Find relevant sites for your ads

Build and analyze your media plan

Tutorials

Features
Google Ad Planning

- $n$ advertisers, and set $Y$ of impressions (items).
- Each advertiser $i$
  - Interested in a set $J_i$ of impressions, (e.g., young women in Seattle),
  - Needs $d_i$ impressions (Demand),
  - Value $v_{it}$ (or Bid $b_i$) for each impression $t$,

Efficiency (or Revenue) Maximization: Find an assignment with the maximum value.
Online Display Ad

- When page arrives, assign an eligible ad.
  - value of assigning page $i$ to ad $a$: $v_{ia}$
- Display Ads (DA) problem:
  - Maximize value of ads served: $\max \sum_{i,a} v_{ia}x_{ia}$
  - Capacity of ad $a$: $\sum_{i \in A(a)} x_{ia} \leq C_a$
AdCell Auction

ShopAlerts by AT&T

Know What’s Hot

Get text alerts about new products, special offers, and events from your favorite brands when you are nearby stores. It all comes included with America’s best wireless service.

Get Started

Phone Number: *(Required Field)*
Age Range: *(Choose one)*
E-mail:
Zip Code: *(Choose one)*
Gender:

I accept the Terms and Conditions and have read the Privacy Policy.

Join Now

ShopAlerts is currently available in Chicago, Los Angeles, New York City, and San Francisco.
AdCell Auction

- Online Advertising
  - Major source of revenue

- AdCell vs AdWords
  - Intrusive delivery (SMS, MMS, etc)
  - Limited number of Ads per customer
  - System generated queries

- ShopAlerts by AT&T
AdWords vs AdCell

**AdWords**

Search Queries: (keywords)

**AdCell**

System Generated Queries: (customer id, location, time)

Advertisers:
Customer Policy

- AdCell is intrusive
- Incentivizing customers
  - Discount on service plan if they opt in
  - Limited number of ads per month
1. Advertisement with Ad# Via SMS

4.2. Confirmation # & Acquired Points Via SMS

2. Purchase with Ad#

3. Reporting the Purchase with Ad#

4.1. Confirmation #

5. Confirmation #

Customer

Wireless Provider

Store
Online Bipartite Matching

- All these three problems are generalizations of Online Bipartite Matching:
- The input to the problem is:
  - bipartite graph $G = (V_1 \cup V_2, E)$
  - $V_1$ is the set of advertisers and $V_2$ is the set of keywords
  - the vertices in $V_2$ (keywords) arrive in an on-line fashion
  - the edges incident to each vertex $u$ in $V_2$ are revealed when $u$ arrives and determine the advertisers who want keyword $u$.
- When $u$ arrives, the algorithm may match $u$ to a previously unmatched adjacent vertex in $V_1$, if there is one.
- Such a decision, once made, is irrevocable.
- The objective is to maximize the size of the resulting matching.
Online Bipartite Matching: Greedy

- Any **greedy** algorithm that always matches a vertex in $V_2$ if a match is possible constructs a maximal matching, and therefore such an algorithm has a **competitive ratio** of $\frac{1}{2} = 0.50$ (by a double counting argument).

- **Competitive ratio**: The ratio of our algorithm to the best (optimum) offline algorithm.

- On the other hand, given any deterministic algorithm, it is easy to construct an instance that forces that algorithm to find a matching of size no greater than half of the optimum.
Online Bipartite Matching: Randomized

- Any randomized algorithm that chooses a single random ranking on the vertices in $V_1$
- When a vertex $u$ in $V_2$ arrives among its unmatched neighbors assign $u$ to the one than has the highest ranking
- This produces a competitive ratio $1 - 1/e \approx 0.63$
- This is the best that we can do in the online world.
- However, if we know stochastic information like distributions of the keywords (the probability that a node $u$ in $V_2$ arrives) and also the budget to the bid ratio is very large, we can obtain a competitive ratio very close to 1.
Summary

- Online Advertisement Auctions
  - AdWord Auctions
  - Display Ad Auctions
  - AdCell Auctions