Advertising Engines

A Guide to Web Research: Lecture 1

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Steklov Institute of Mathematics at St.Petersburg

Stuttgart, Spring 2007

YAHOO! SEARCH MARKETING

Microsoft adCenter

Google AdWords

Google AdSense

new algorithmic problems

new models and notions

Talk Objective

Industrial solutions

- Google AdWords
- Google AdSense
- Yahoo! SearchMarketing
- Microsoft adCenter
- Amazon recommendations
- Coming soon: personalized ads for webmail, social networks, blogging platforms, phones, computer games, supermarket bills etc.

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Today we show
(1) single model for distributing personalized ads
(2) open algorithmic problems motivated by such systems

Outline

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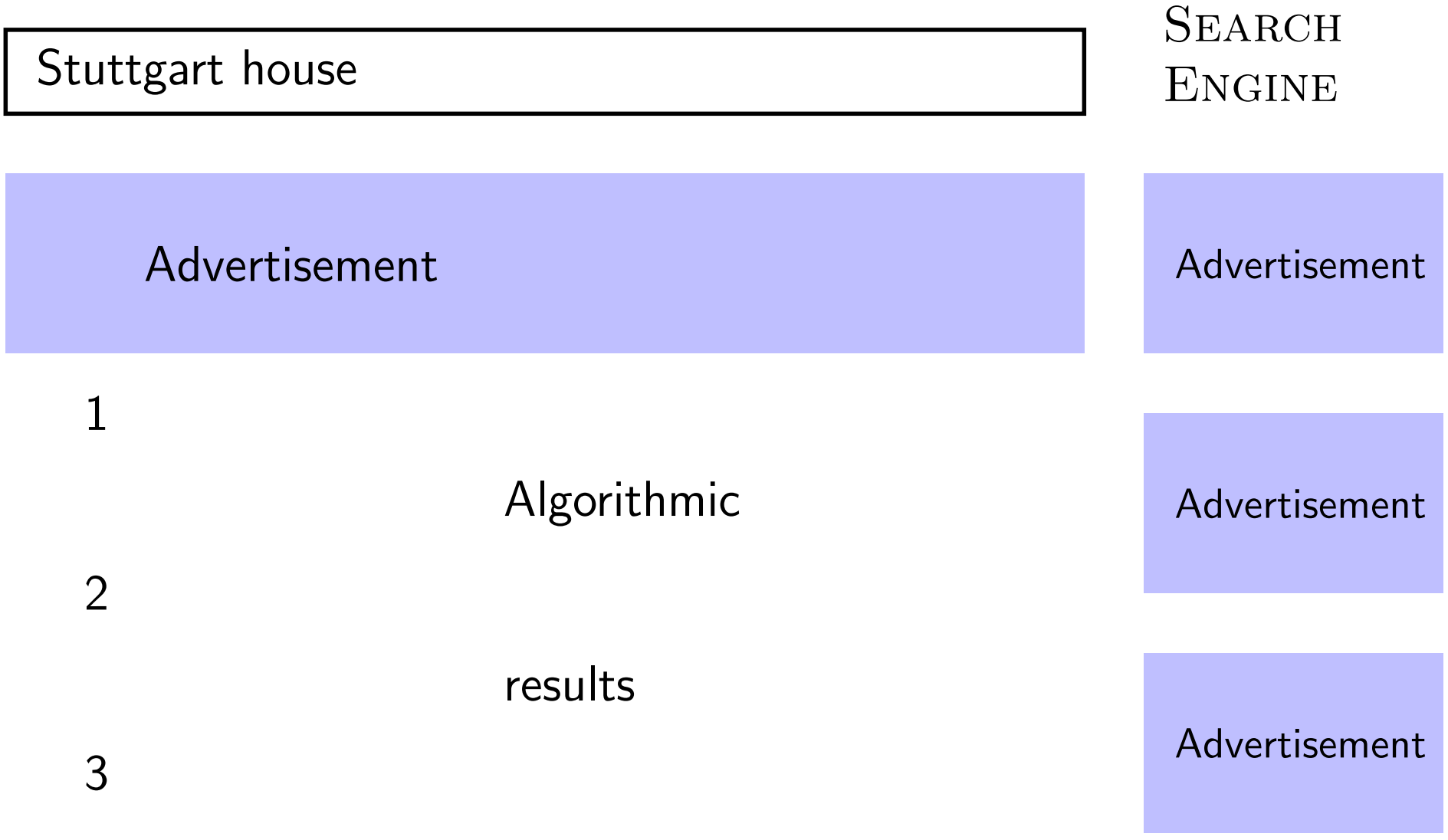
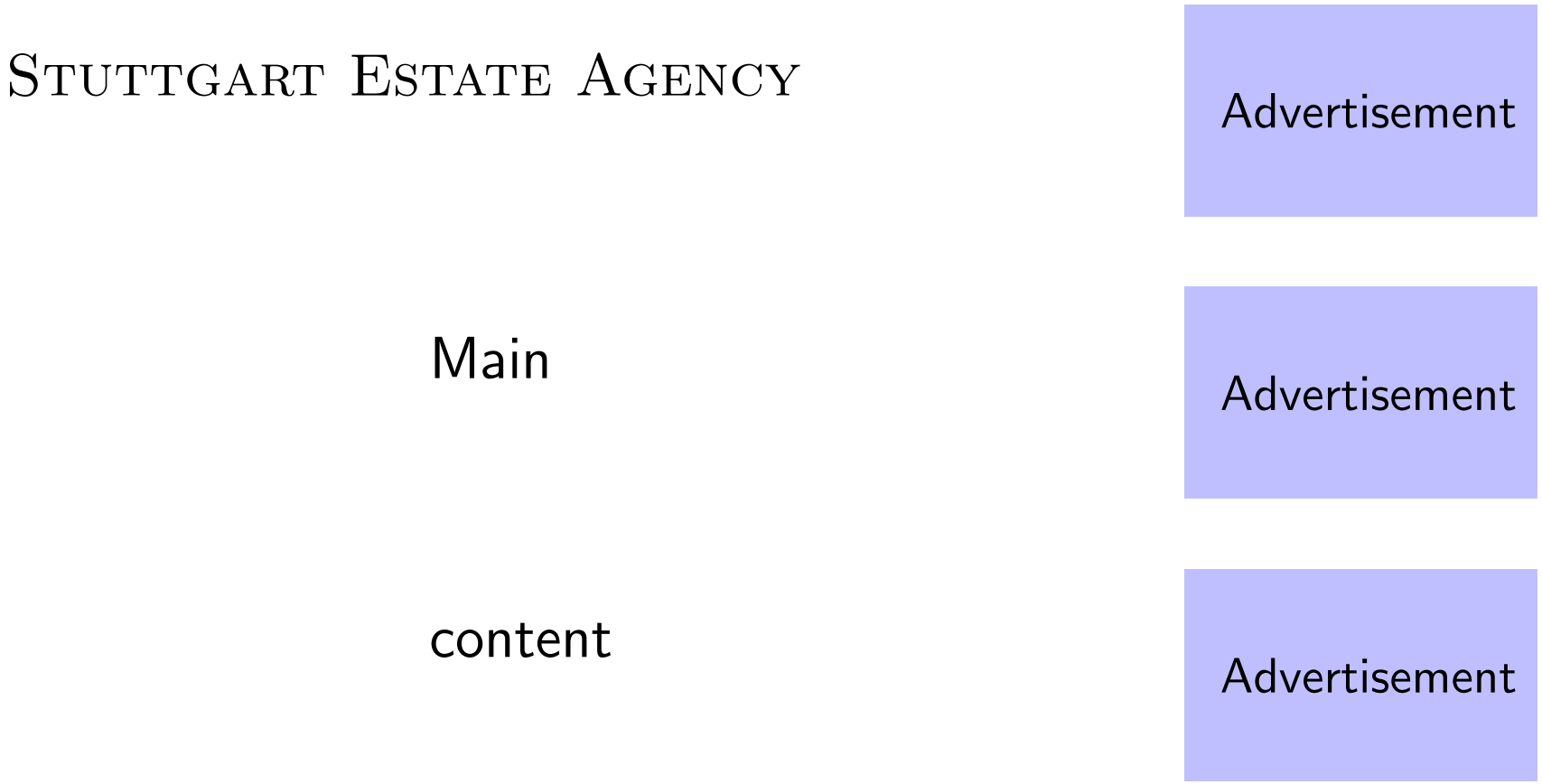
1. Architecture of Advertising Engines
   - Component 1: Event
   - Component 2: Advertiser
   - Component 3: Advertising Engine
2. Algorithmic Challenges
   - Target optimization
   - Click Volume
   - AdRank Computing
   - Ad Coverings

Part I: Architecture of Advertising Engines

Example: Sponsored Search



Example: Context Ads



Three Components: Event, Advertiser, Engine

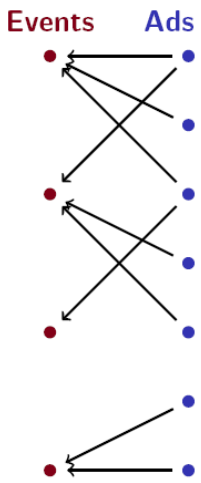
Event

Person
Media
Action

Advertiser

Ad
$$$
Targeting

Advertising Engine



Choosing procedure

Pricing mechanism

Component 1: Event

Collect all available information:

- Person: What do we know about him/her?
  - Age, geographic location, previous actions, interests etc
- Media: What is situated around the ad placement?
  - Content and typical audience of website, tv program, newspaper
- Action: Current relations between person and media?
  - Current search query, purchasing a book, signing up to a service

Component 2: Advertiser

Setting new campaign:

- Ad: What will be displayed?
  - Text, image, video, hyperlink, phone number, advertiser's website
- $$$: Size of campaign?
  - Monthly/daily budget, maximal admissible price (bid) for click/impression
- Targeting: Who is target audience?
  - Location, specific query keywords, category of landing page

Targeting in general: any subset of event space $P \times M \times A$

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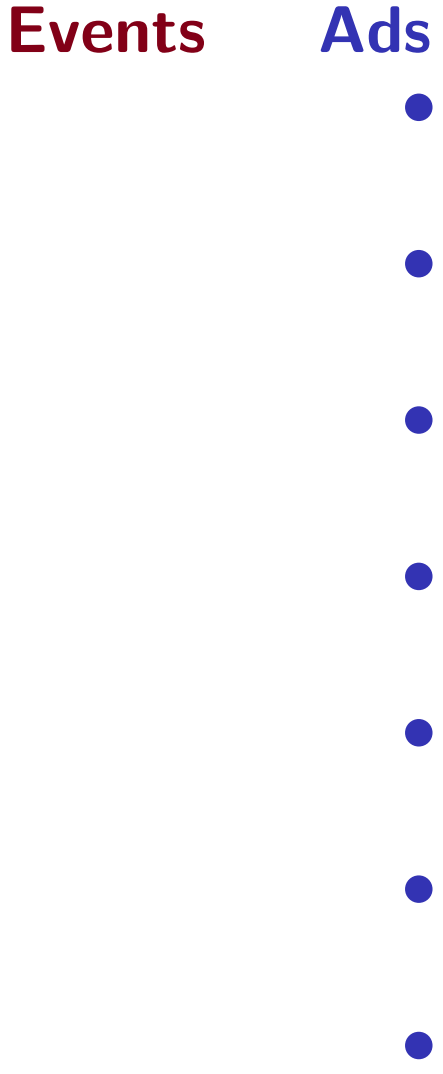

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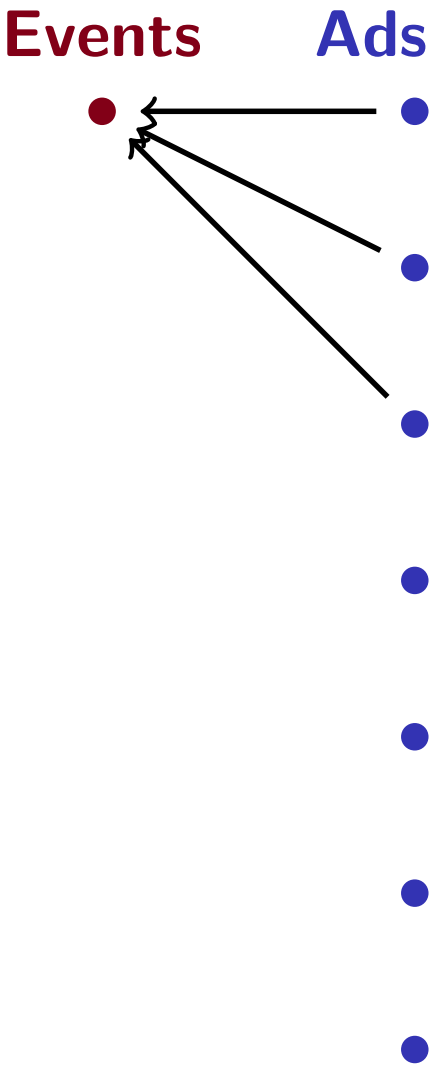

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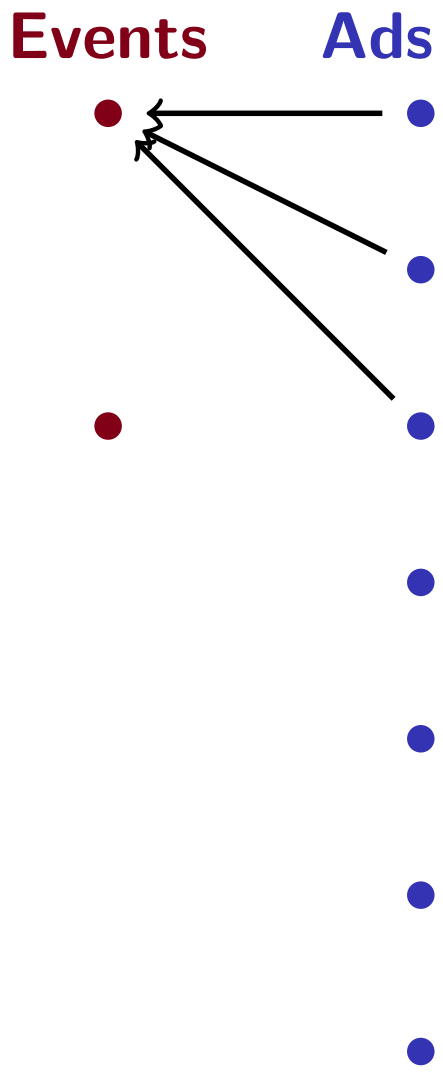

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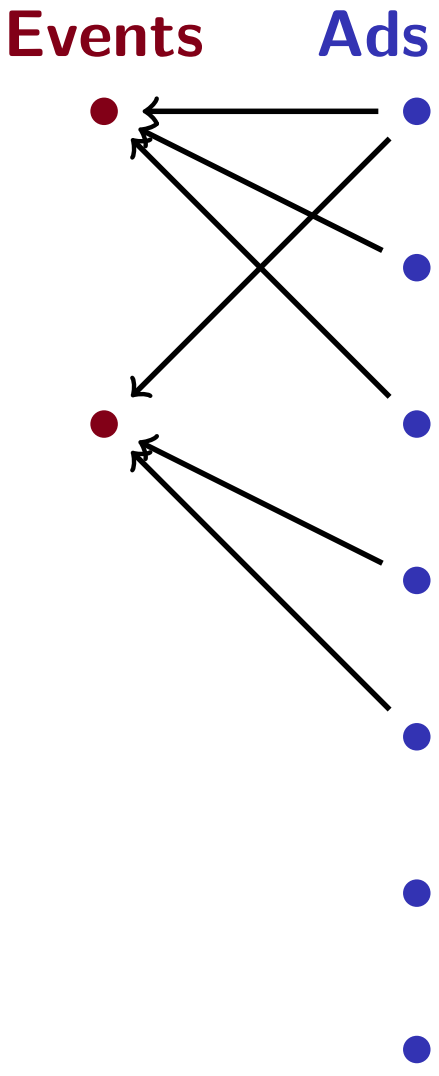

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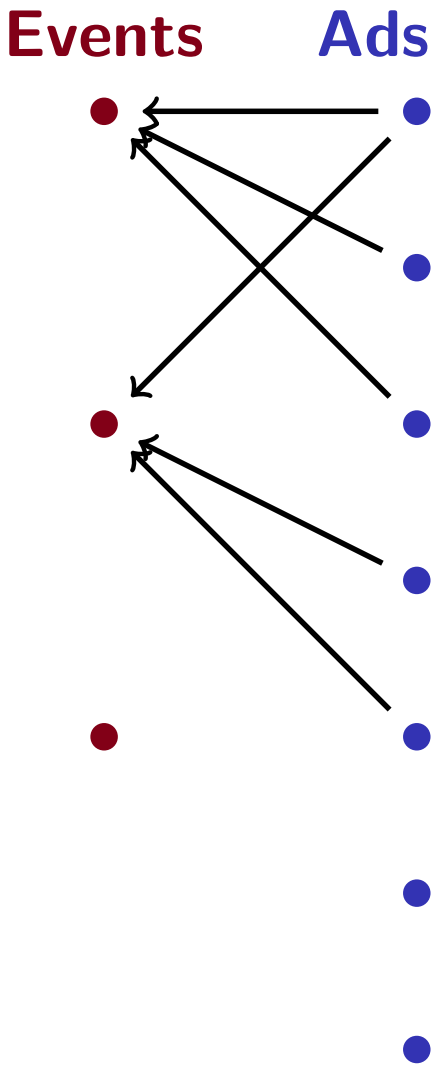

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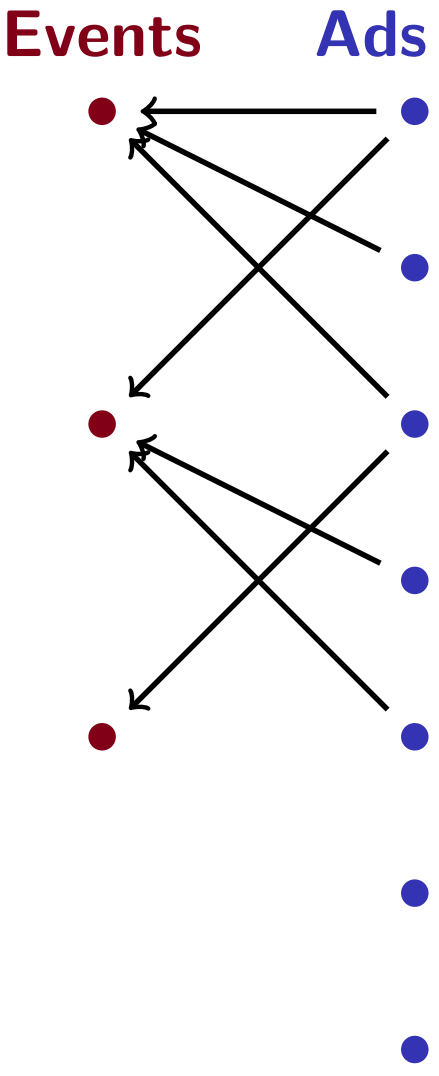

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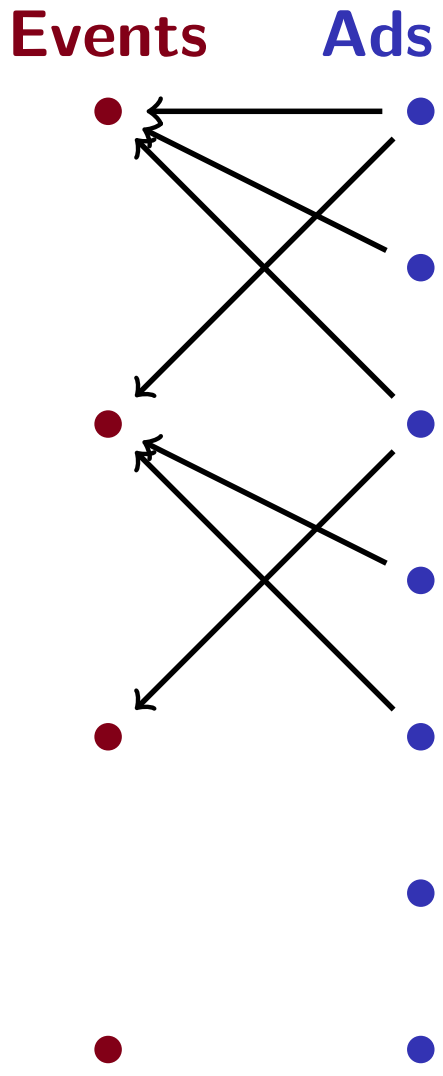

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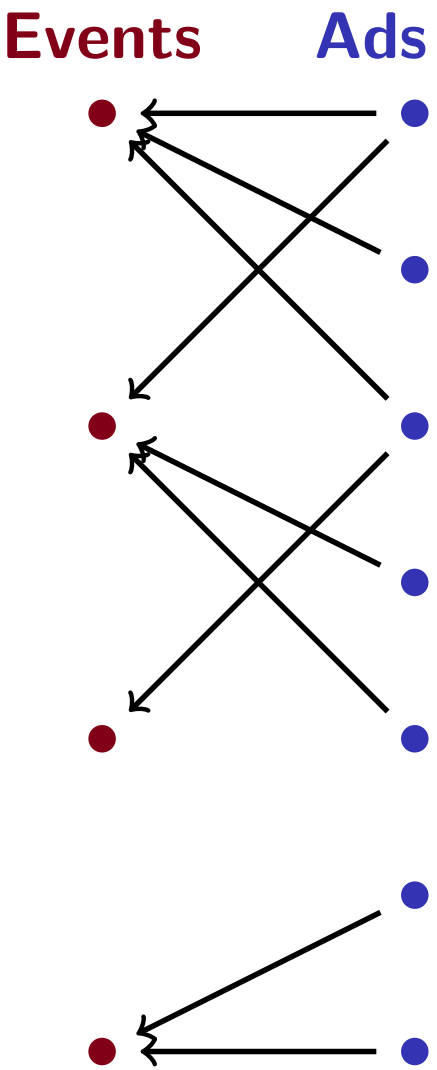

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More objectives?

Part II: Algorithmic Challenges

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Disclaimer: my style is

1. At first, think independently (e.g. pose new problems)
2. **Only after that** look into literature

Hence, the following problems might be already known and heavily studied!

Target optimization (1/4) Informally

Advertiser sets target audience. **Advertising engine should help:**

- Some potentially interested people are missed
- Exclude people who will be offended by this ad
- Proper setting of target audience is difficult
- Advertising engine knows much more about event space

Target optimization (2/4) Formalization

Events are vectors

Advertiser provides some **sample** events $S = \{e_1, \ldots, e_k\}$ from the target

Advertising engine produces an effective membership procedure for **optimized target** $\bar{S}$

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How to define **optimized target**?

Target optimization (3/4) Solution

Let $B(e, r)$ be the ball in event space with center e and radius r

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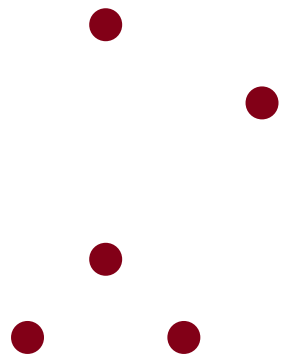

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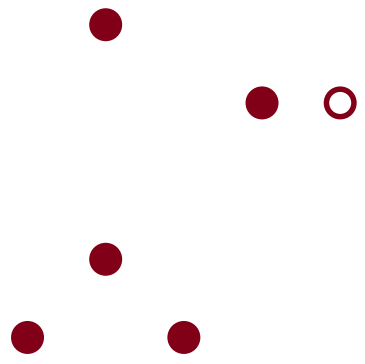

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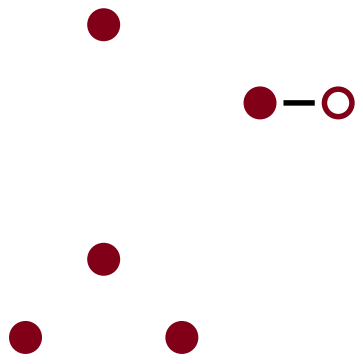

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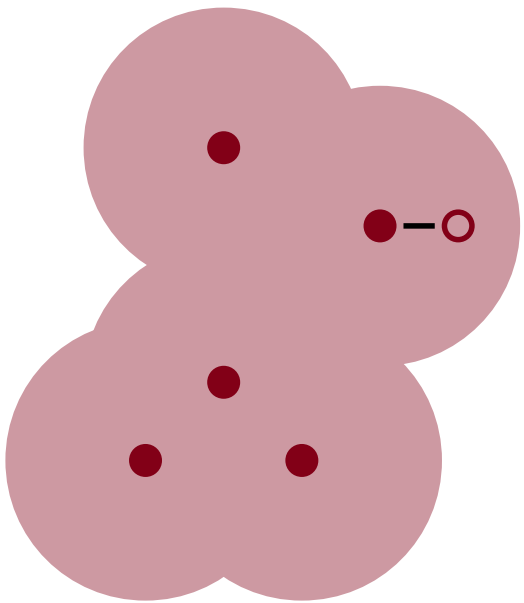

Target optimization (4/4) Questions Around

- Other definitions for optimized target?
- Exploiting historical information for target optimization
- Target construction based on advertisement content

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- Understand how much can we sell
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- Use different strategies for (supply$<$demand) and (supply$>$demand)

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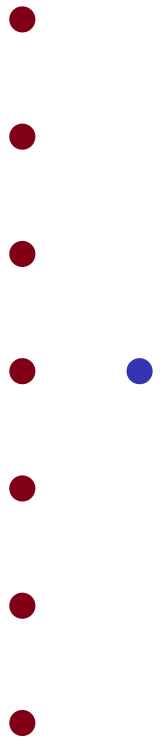

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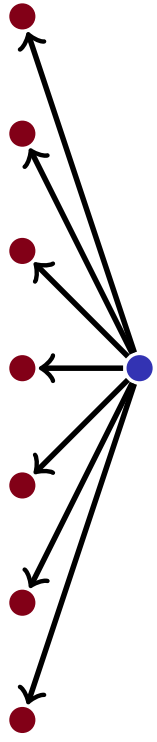

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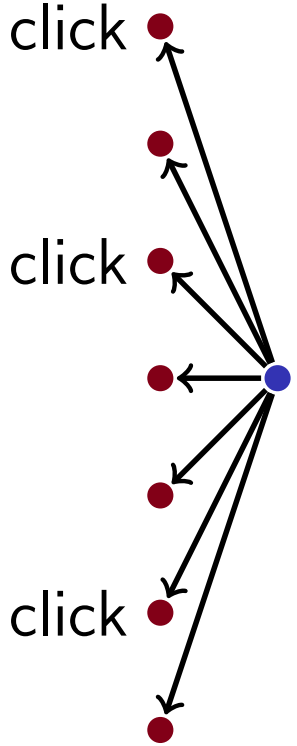

Click Volume (2/4) Basic Formula

Take daily history **event-ad-?click**:

$$(e_1, a_1, b_1) \ldots (e_n, a_n, b_n)$$

Use similarity-between-ads function S for computing click volume V:

$$V(a_{new}) = \sum S(a_{new}, a_i) \cdot b_i$$

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Any comments/objections?

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First step: prediction of click-through rate for a given **event-ad** pair

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Second step: using click rates

$$V(a_{new}) = \sum_{1 \leq i \leq n} CTR(e_i, a_{new})$$

Click Volume (4/4) Questions Around

- Computing ad volume (the amount of advertisements that can get positive response at the given event)
- Fast algorithm for predicting click volume for all ads in the system
- Exploiting metric inside event space

AdRank Computing (1/2) Informally

Input: event e_{new}, set of all ads A. **Choosing-ads principles:**

- Take the most content-relevant
- Take the ones with best click-through rate
- Take ads with maximal bids

$$AdRank(e_{new}, a) = Bid(a) \cdot (ContRel(e_{new}, a) + CTR(e_{new}, a))$$

AdRank Computing (2/2) Questions Around

Actually, finding content-closest ads to the given input is just the nearest neighbor problem. **We need:**

- Data structure for A for fast computing of best $AdRank(e_{new}, a)$ values
- Accurate and fast prediction for $CTR(e_{new}, a)$

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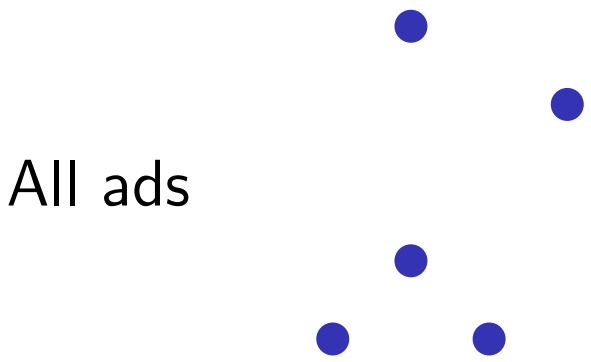

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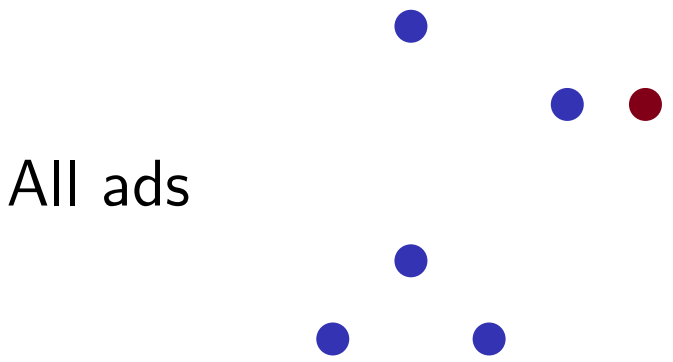

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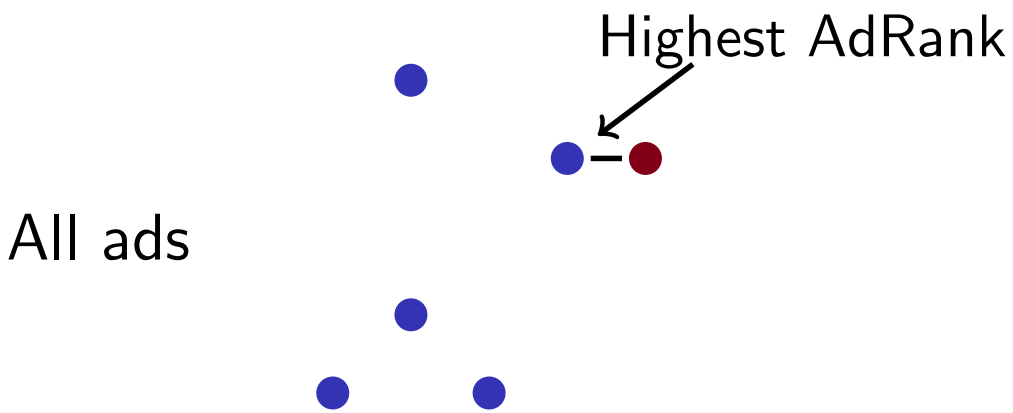

Ad Coverings — Informally

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- What is the minimal amount of placements to cover all (target) audience?
- Given fixed amount of placements how many subscribers can we cover twice?

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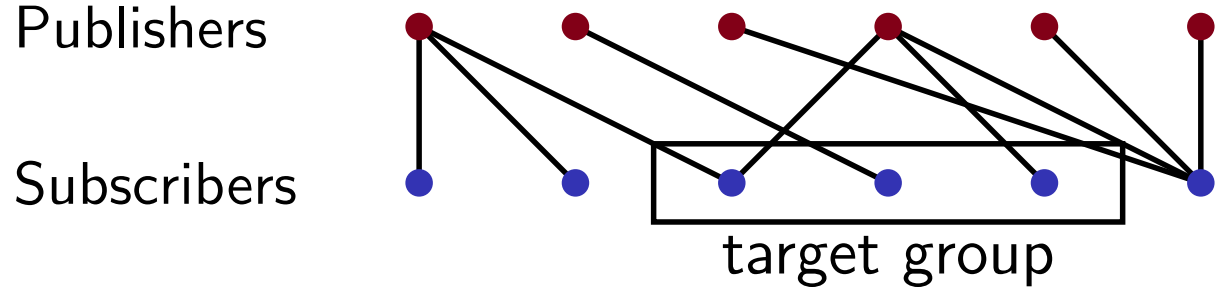

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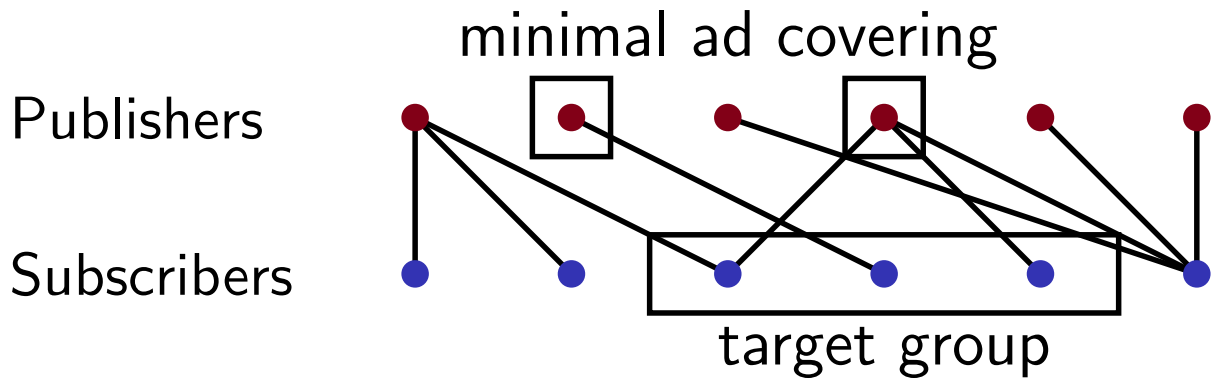


Other Directions in Advertising Engines

- Optimal ad distribution in case when interested audience is larger than budget
- Machine learning for advertising engines
- Weighted targeting (some events are preferable to others)
- Advertising engines for social networks
- Auction design for sponsored search
- Click fraud

Call for participation

Know a relevant reference?

Have an idea?

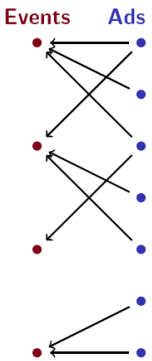
Find a mistake?

Solved one of these problems?

- Knock to my office 1.156
- Write to me `yura@logic.pdmi.ras.ru`
- Join our informal discussions
- Participate in writing roadmap-paper

Summary

Three components:



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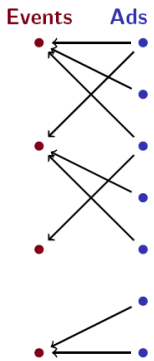

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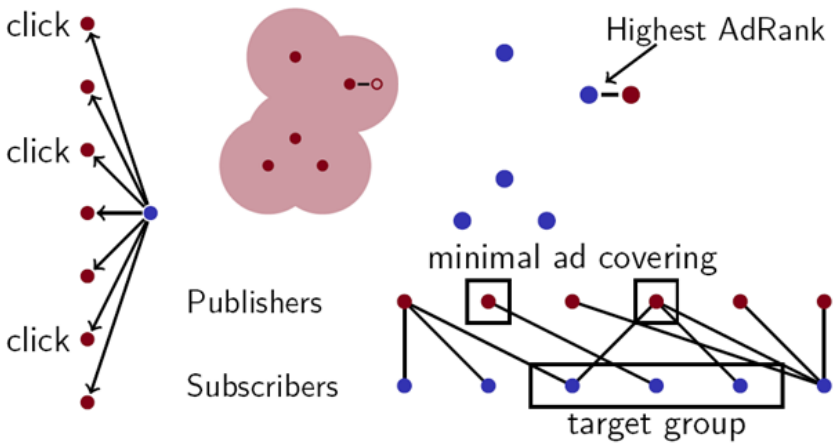

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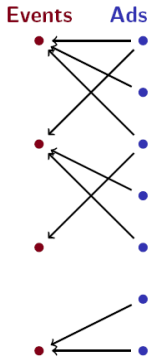
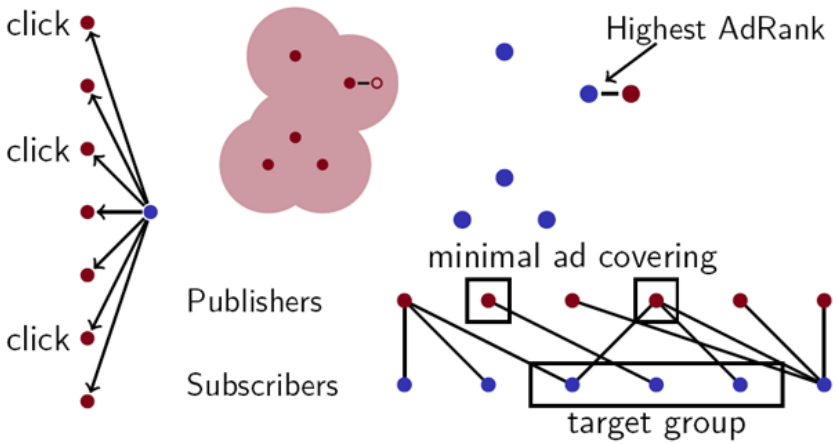


FOR SALE

www.home.org

Four problems:



Vielen Dank für Ihre Aufmerksamkeit! Fragen?

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