Sponsored Search Markets

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how one makes money on the web

Introduction

Web search

Game Theory

Auctions

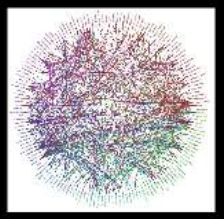
Text Ads

Display Ads

Behavioral targeting

Recommender systems

Privacy



Networks

Emerging areas

Final Presentations

Sponsored Search Markets

fact: keyword based advertizing makes most of Google's revenue

how one makes money on the web

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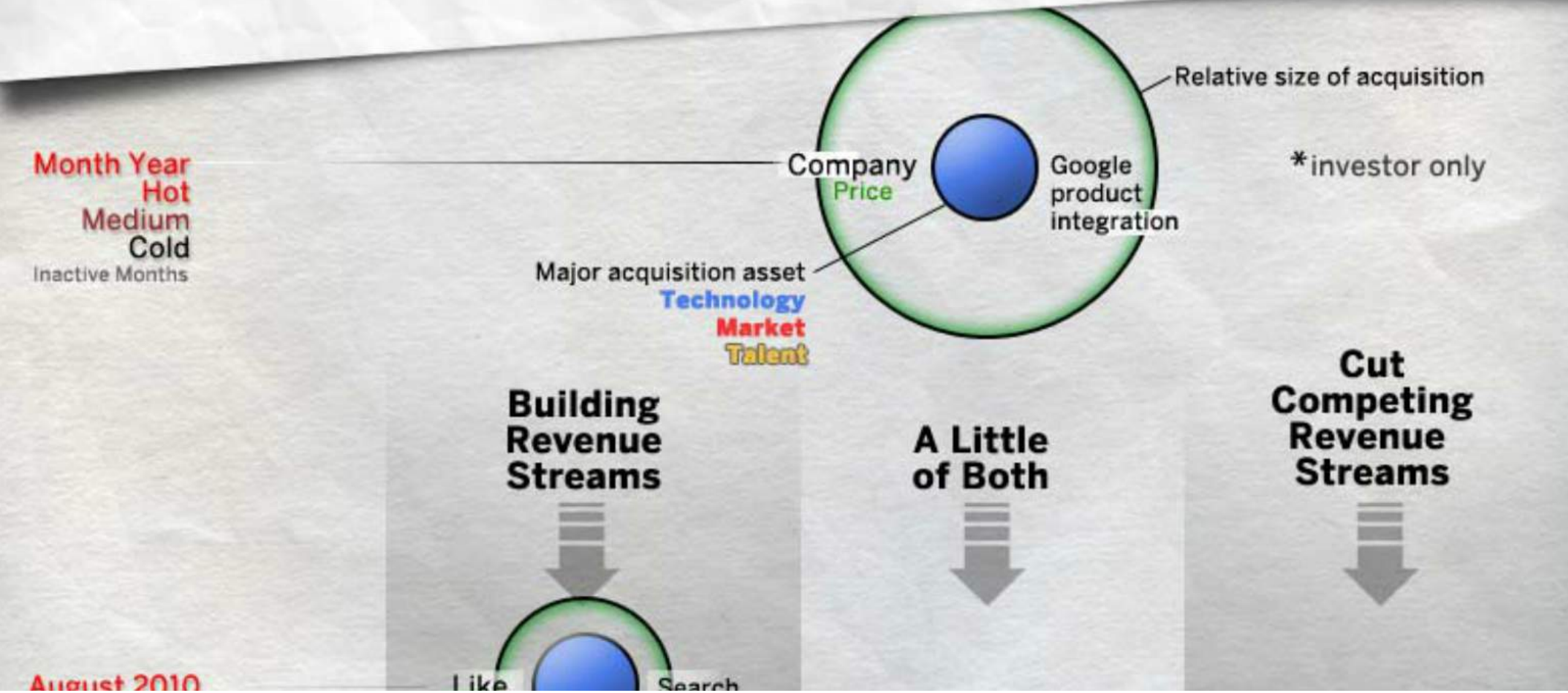
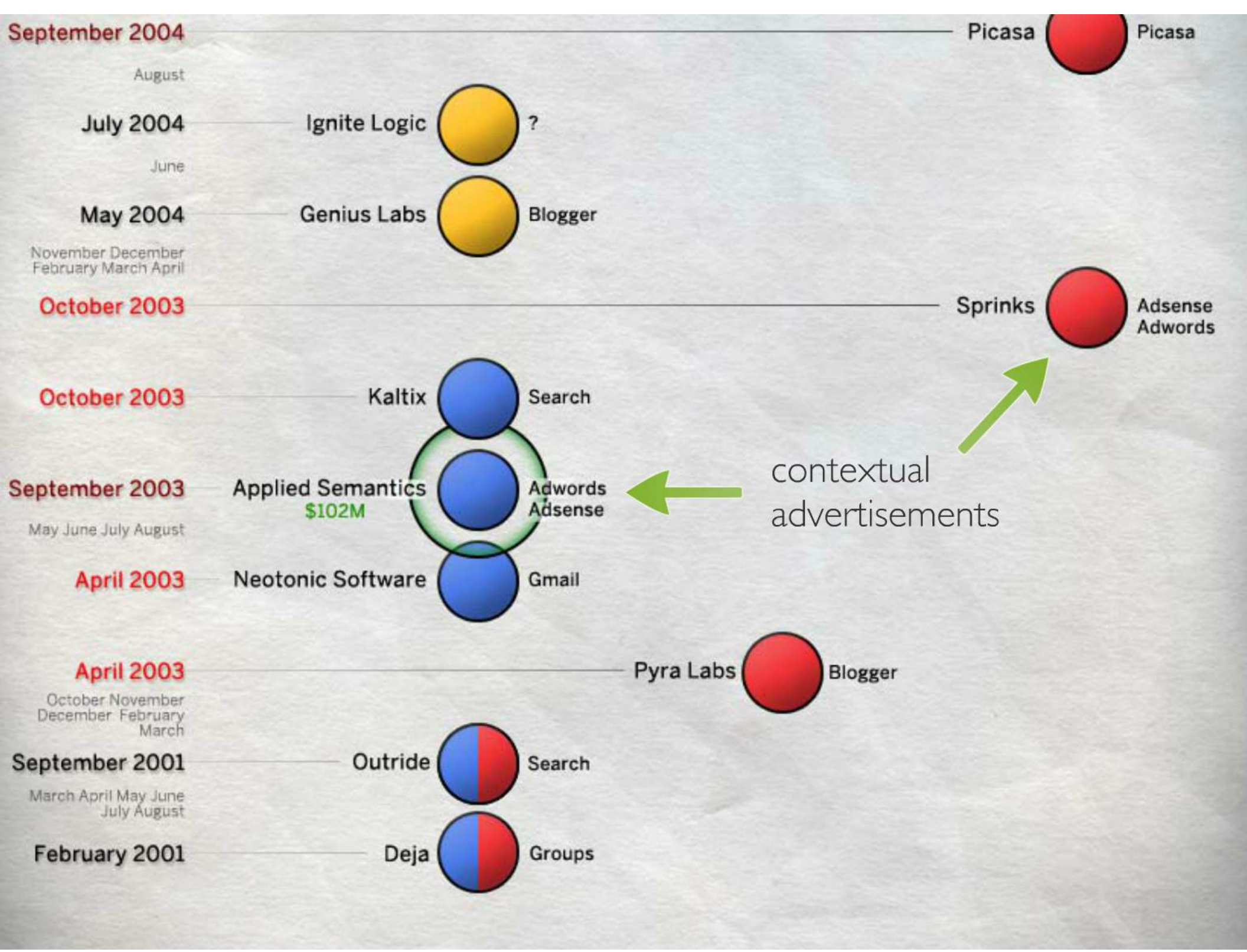
Google(graphic)

Google's Acquisition Appetite

Google Search | I'm Feeling Lucky

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Picasa
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May 2004
Genius Labs
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Adwords
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April 2003
Neotonic Software
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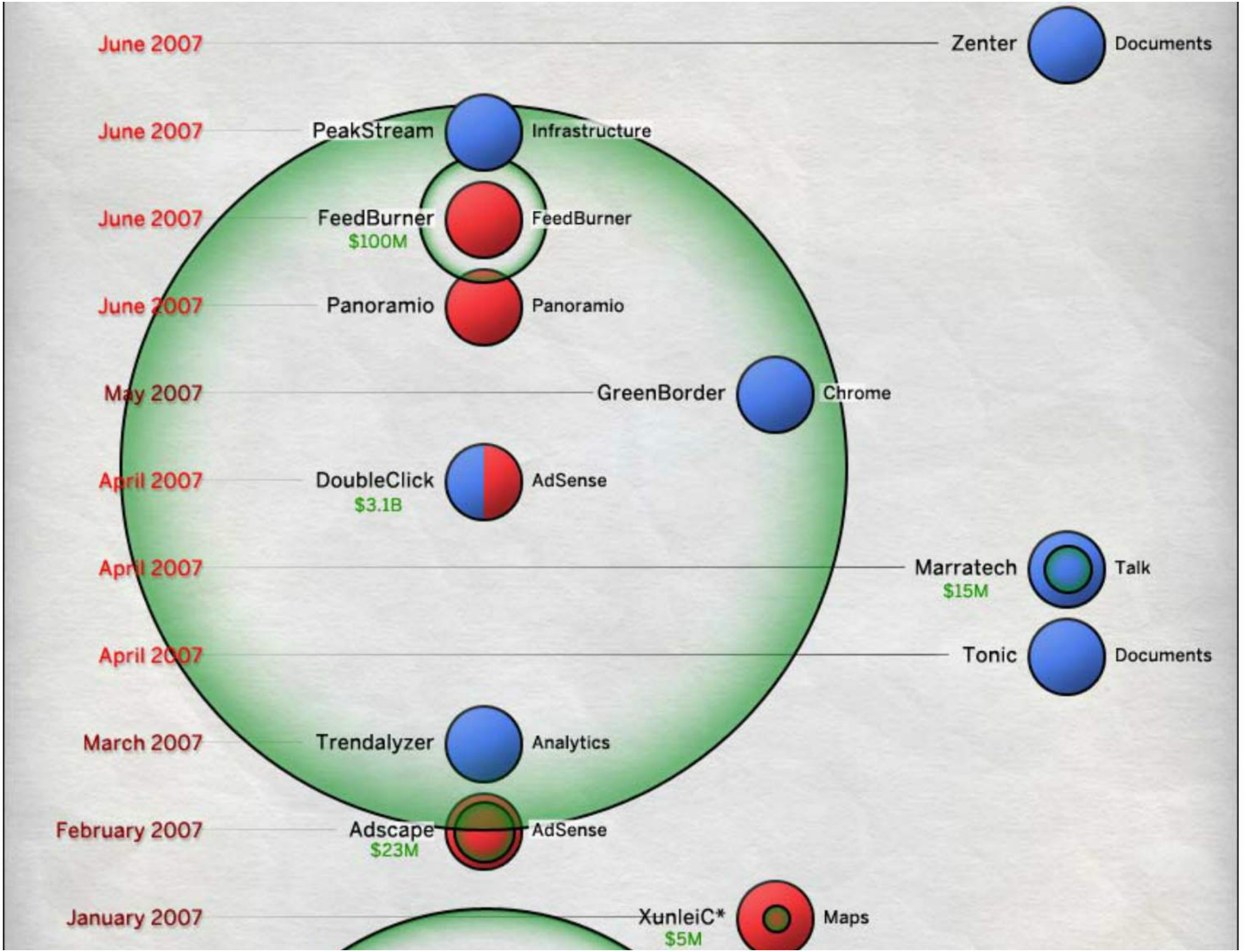
Groups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GreenBorder
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DoubleClick
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AdSense
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Marratech
$15M
Talk
April 2007
Tonic
Documents
March 2007
Trendalyzer
Analytics
February 2007
Adscape
$23M
AdSense
January 2007
XunleiC*
$5M
Maps

Alaska Travel Information

www.**alaska**travel.com

1 (877) 484 5851

Alaska Vacation Packages, Railroad, Hotels & Cruises. Free Guide & Map.

75% off **Alaska** Cruises

www.**alaskan**cruise.com

Huge selection of discounted **Alaska** cruises. All cruise lines.

See your ad here »

paying per click

nted Alaska

paying per click

are auctions the only way to go?

lets assume that we have a list of slots that need to be filled

highest click through rate

1

Alaska Travel Information
www.**alaska**travel.com
1 (877) 484 5851
Alaska Vacation Packages, Railroad, Hotels & Cruises. Free Guide & Map.

2

75% off **Alaska** Cruises
www.**alaskan**cruise.com
Huge selection of discounted **Alaska** cruises. All cruise lines.

See your ad here »

we need to make some assumptions

Advertisers know the click through rates.

2

We assume that the click through rate depends only on the slot itself and not on the ad that is placed there.

3

Third, we assume that the click through rate of a slot also doesn't depend on the ads that are in other slots.

4

We assume that each advertiser has a revenue per click: the expected amount of revenue it receives per user who clicks on the ad.

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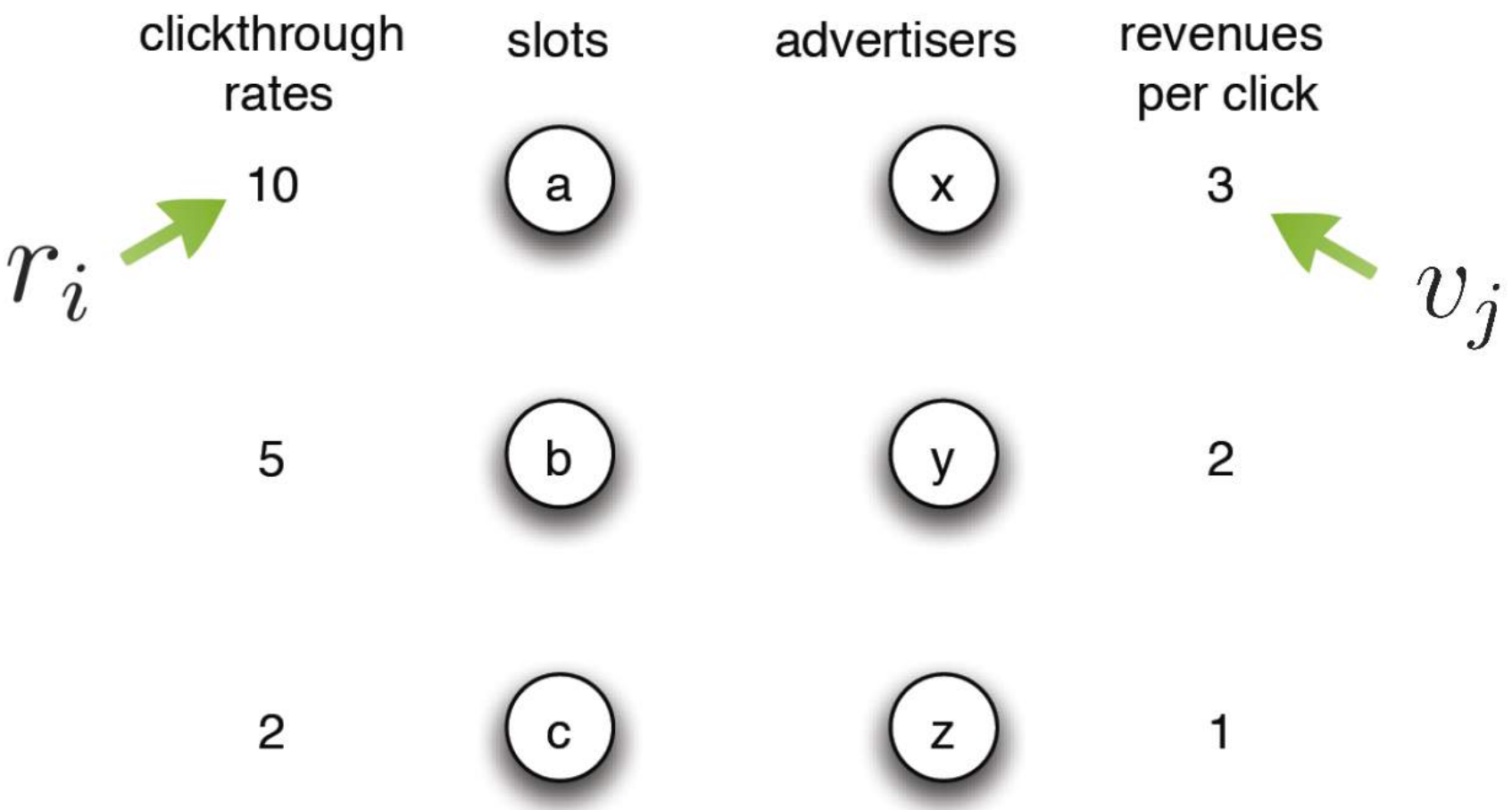
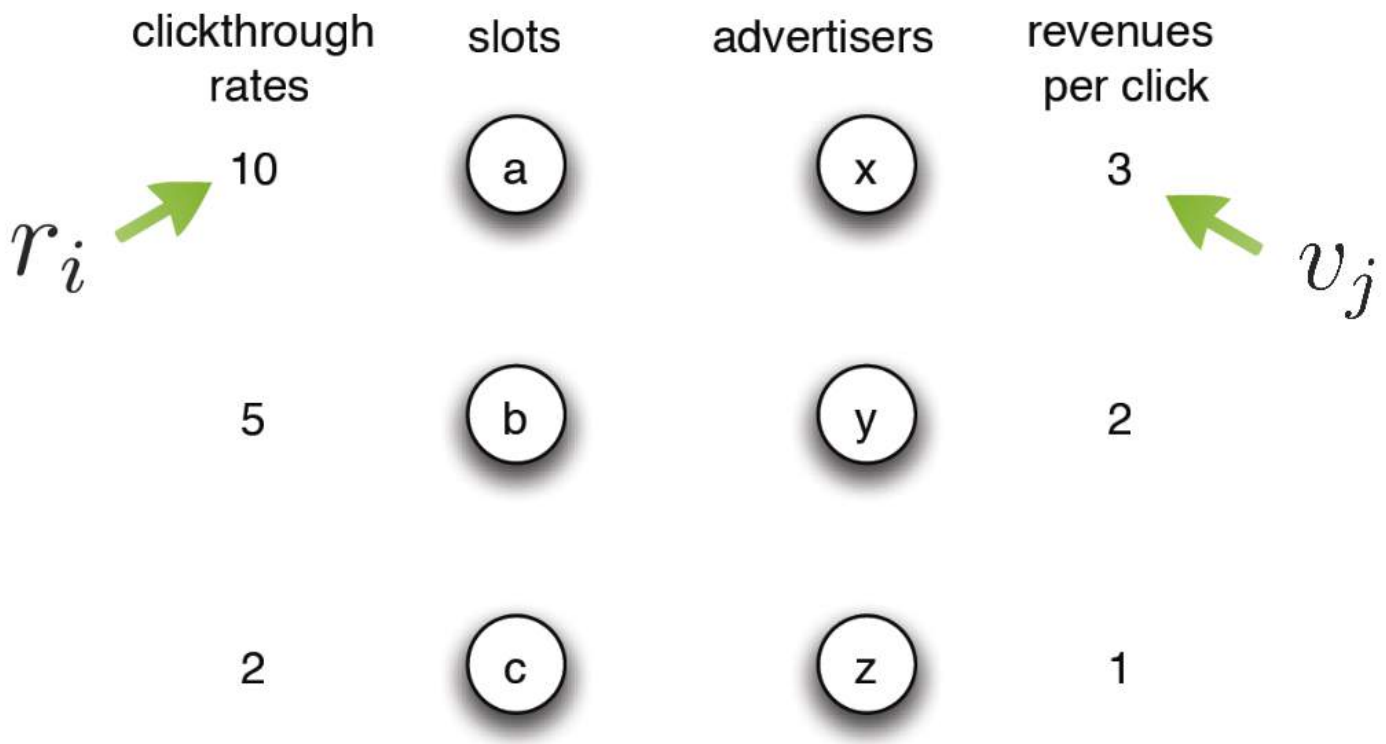
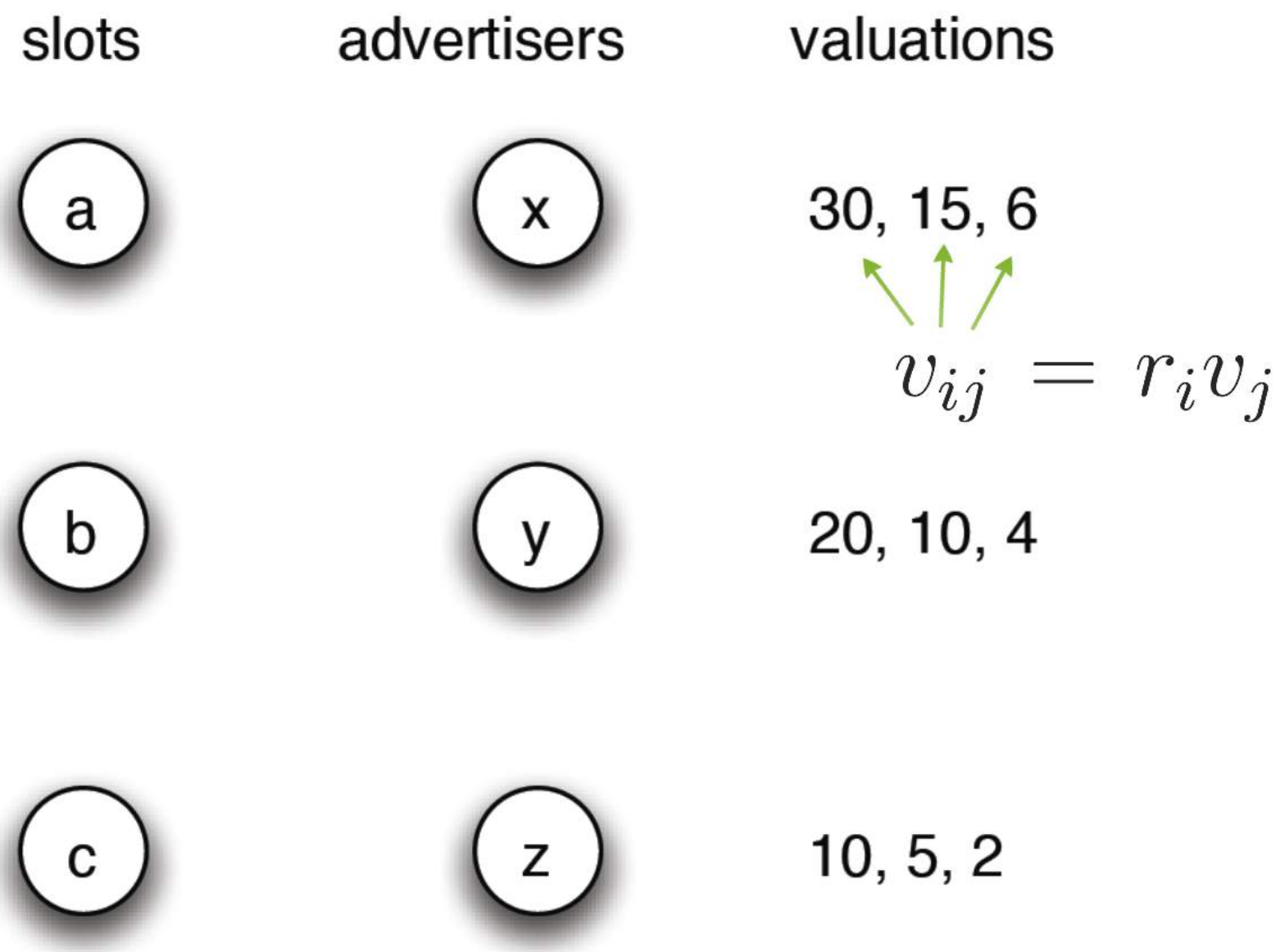
a basic model



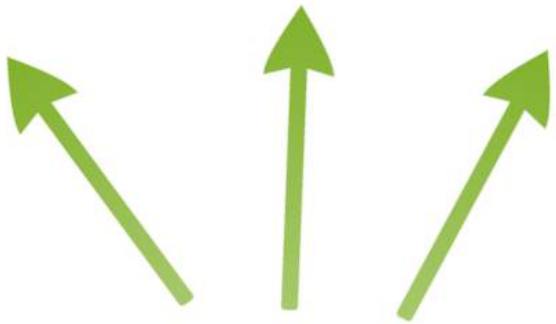
a basic model



$$v_{ij} = r_i v_j$$


slots
advertisers
valuations
a
x
30, 15, 6
$v_{ij} = r_i v_j$
b
y
20, 10, 4
c
z
10, 5, 2

30, 15, 6



$$v_{ij} = r_i v_j$$

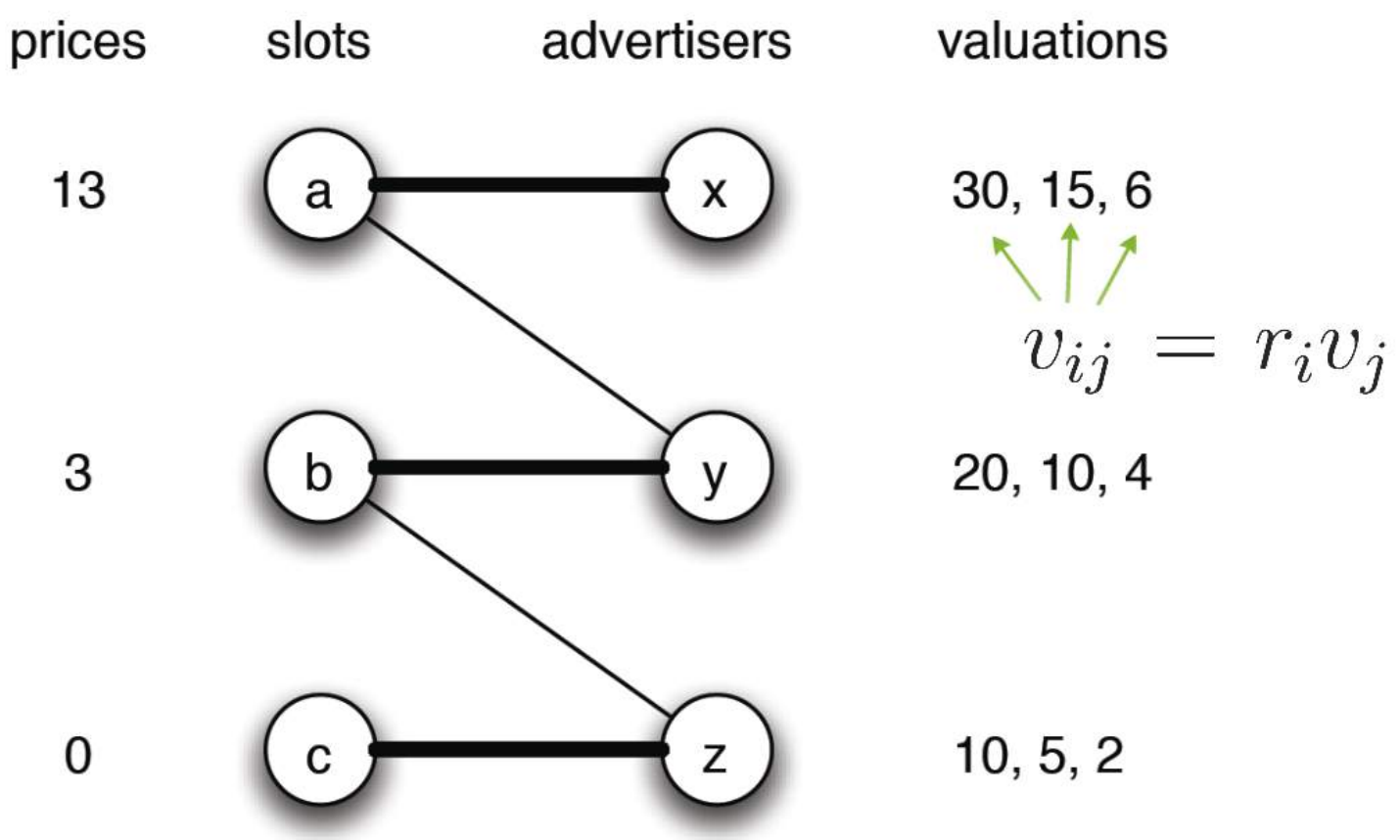
20, 10, 4

Each seller i announces a price p_i

Each buyer j evaluates her payoff for choosing a particular seller i

$$v_{ij} - p_i$$

Build a preferred-seller graph

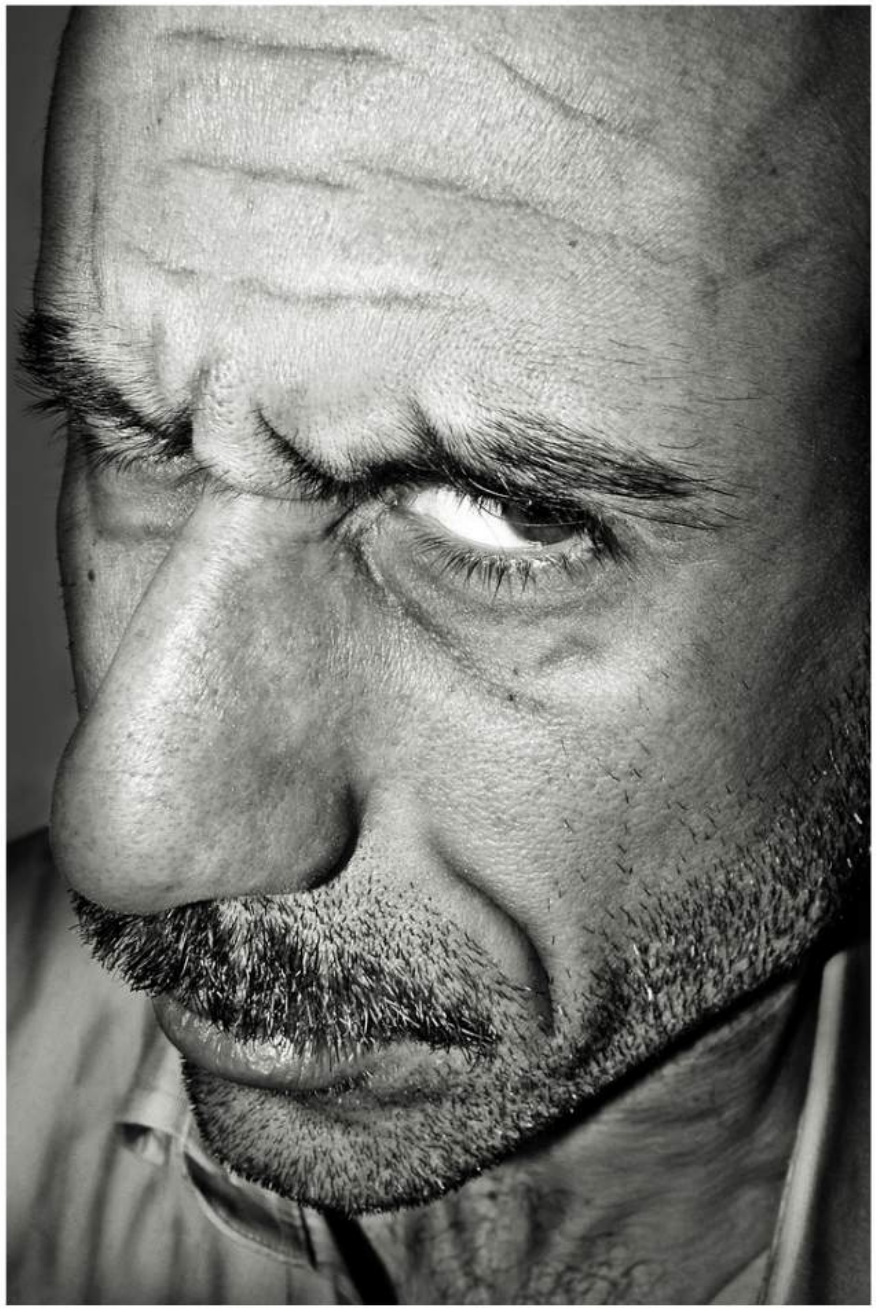


The prices are market-clearing if this graph has a perfect matching

The valuation function can be arbitrary

$$v_{ij} = r_i v_j$$

In reality, search engines do not know the valuations of the advertisers



In the early days, we saw variants of first price auctions: advertisers were simply asked to bid for a slot

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what happened?

VCG auctions are designed to encourage truthful bidding

generalize single item second price auctions

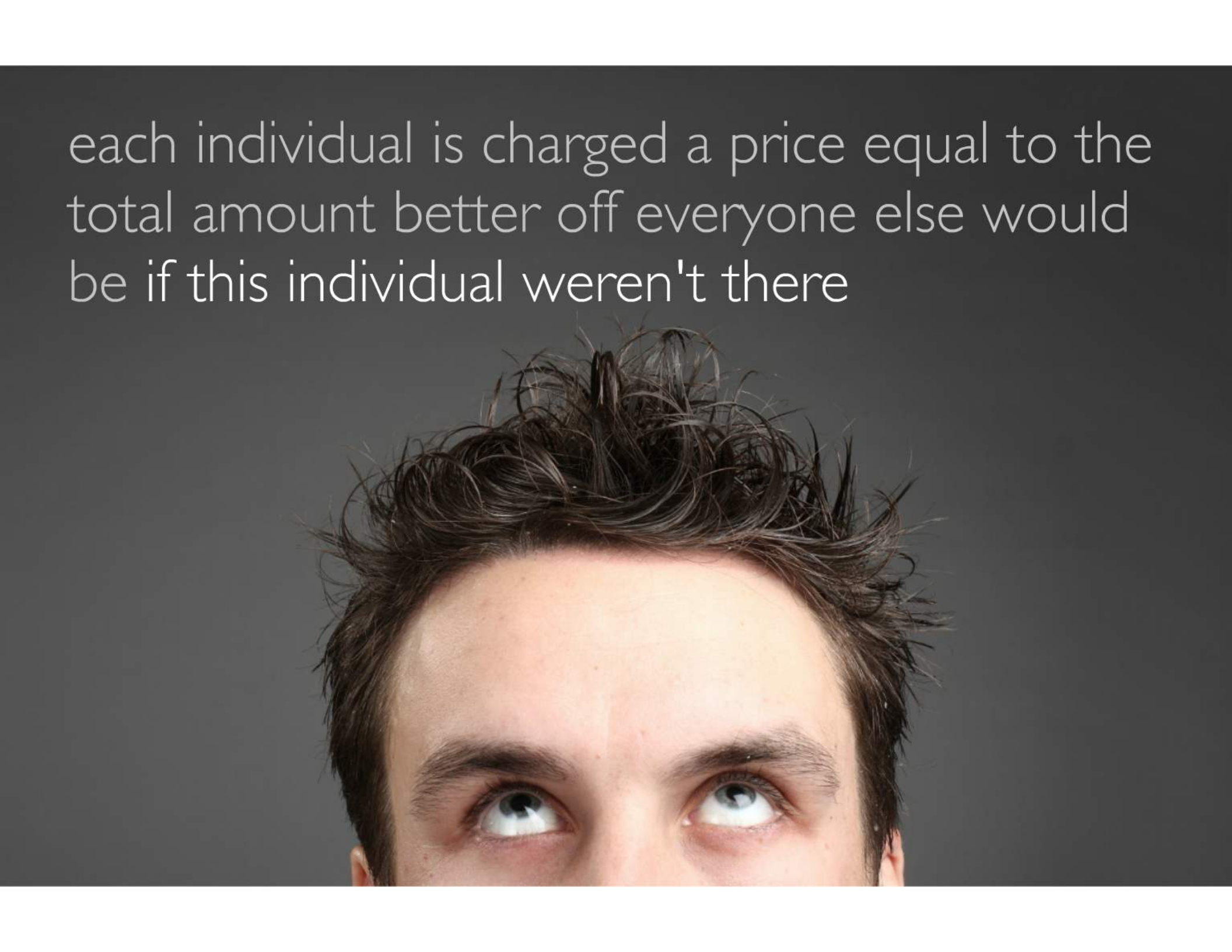
The second-price auction produces an allocation that maximizes social welfare—the bidder who values the item the most gets it

lets assume that we have a set of valuations for one item

$$v_1, v_2, v_3, \ldots, v_n$$

the winner of the auction is charged an amount equal to the "harm" he causes the other bidders by receiving the item

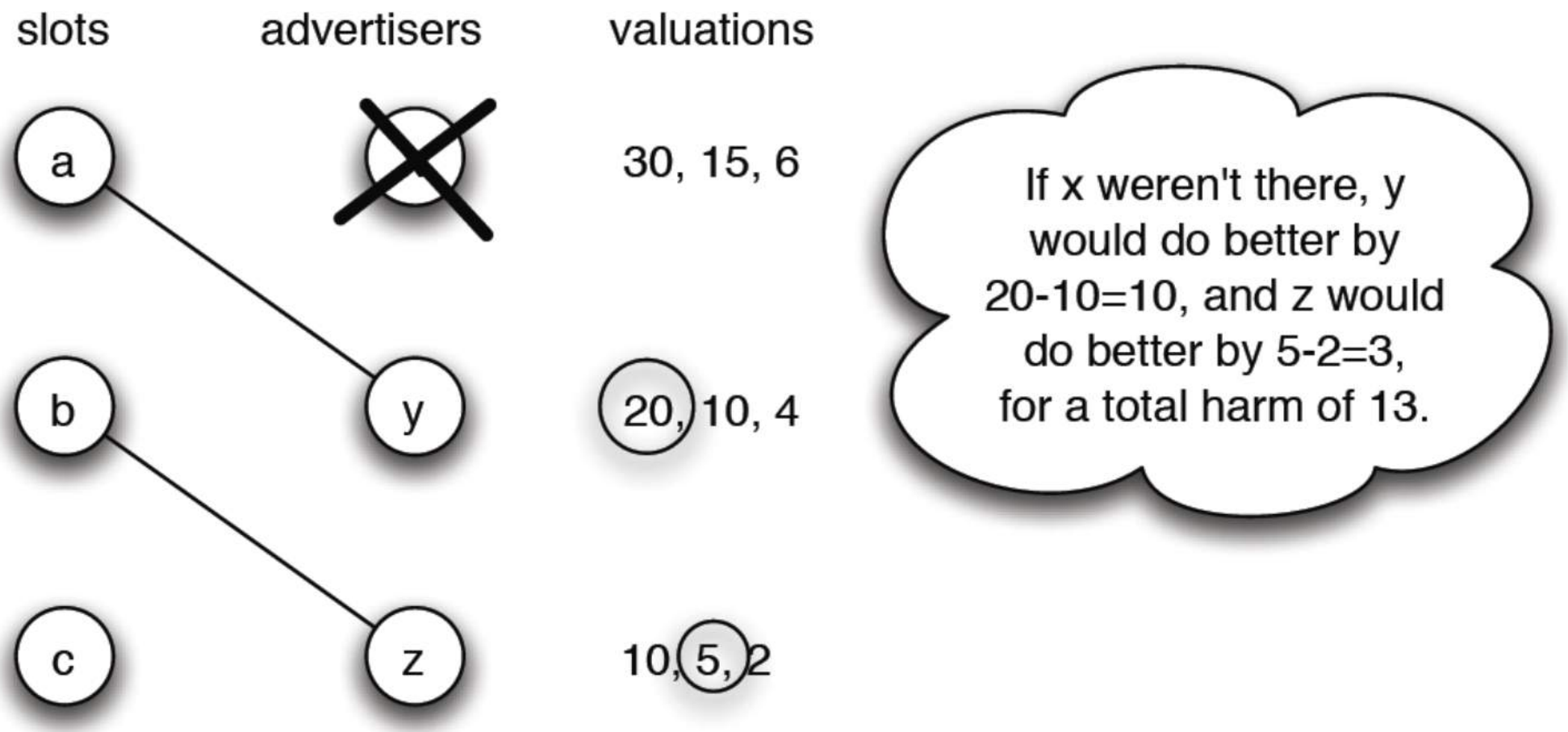
each individual is charged a price equal to the total amount better off everyone else would be if this individual weren't there

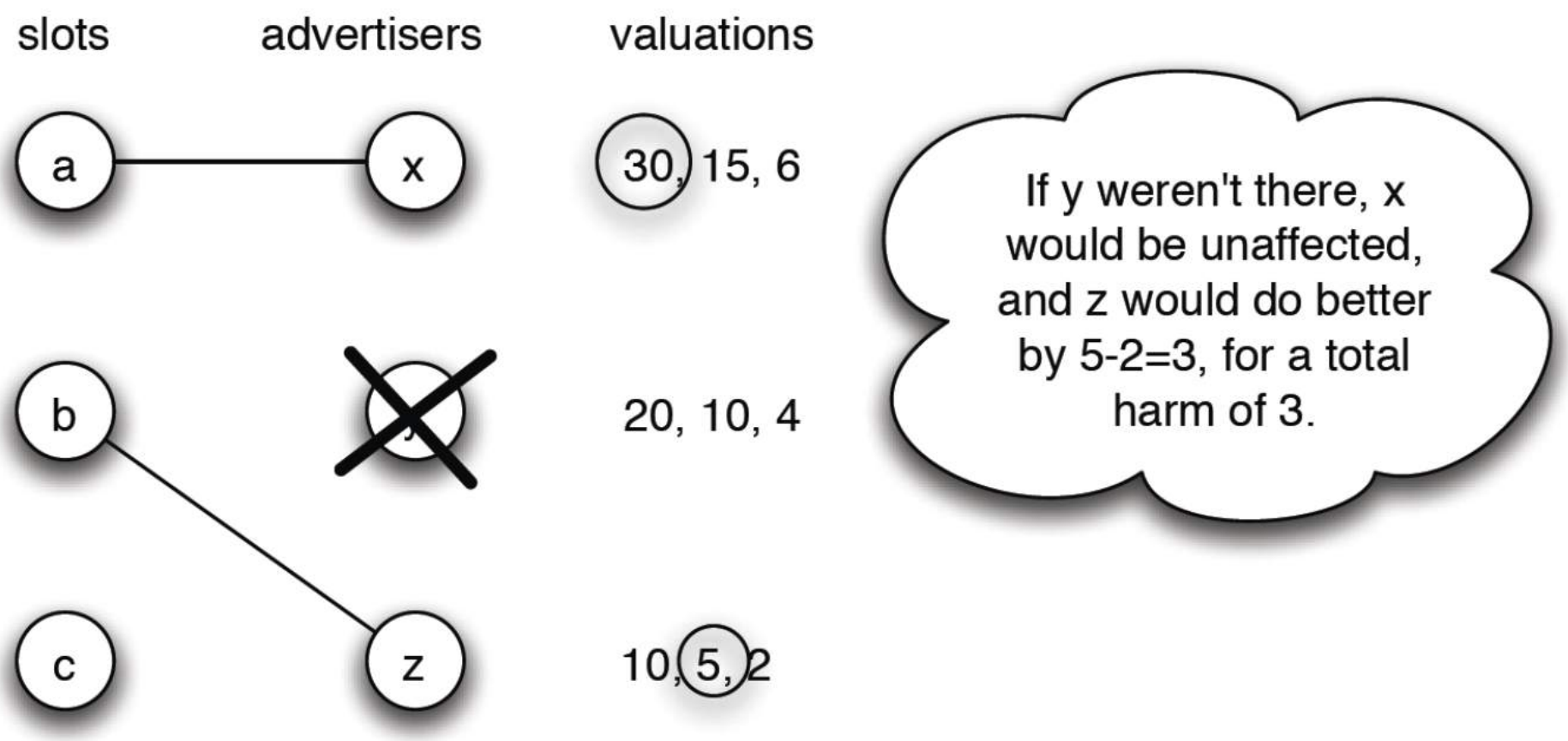


we first assign items to buyers so as to maximize total valuation

2

the price buyer j should pay for seller i's item is the harm she causes to the remaining buyers through her acquisition of this item.


slots
advertisers
valuations
a
b
c
y
z
30, 15, 6
20, 10, 4
10, 5, 2
If x weren't there, y would do better by 20-10=10, and z would do better by 5-2=3, for a total harm of 13.


slots
advertisers
valuations
a
x
30, 15, 6
b
20, 10, 4
c
z
10, 5, 2
If y weren't there, x would be unaffected, and z would do better by 5-2=3, for a total harm of 3.

VCG for the more general case

$$V_B^S$$

social optimum—maximizes valuation

the set of sellers with seller i removed

$$S - i$$

the set of buyers with buyer j removed $B - j$

removing item i and seller j, then the best total valuation the rest of the buyers

$$V_{B-j}^{S-i}$$

if buyer j simply didn't exist, but item i were still an option for everyone else, then the best total valuation the rest of the buyers

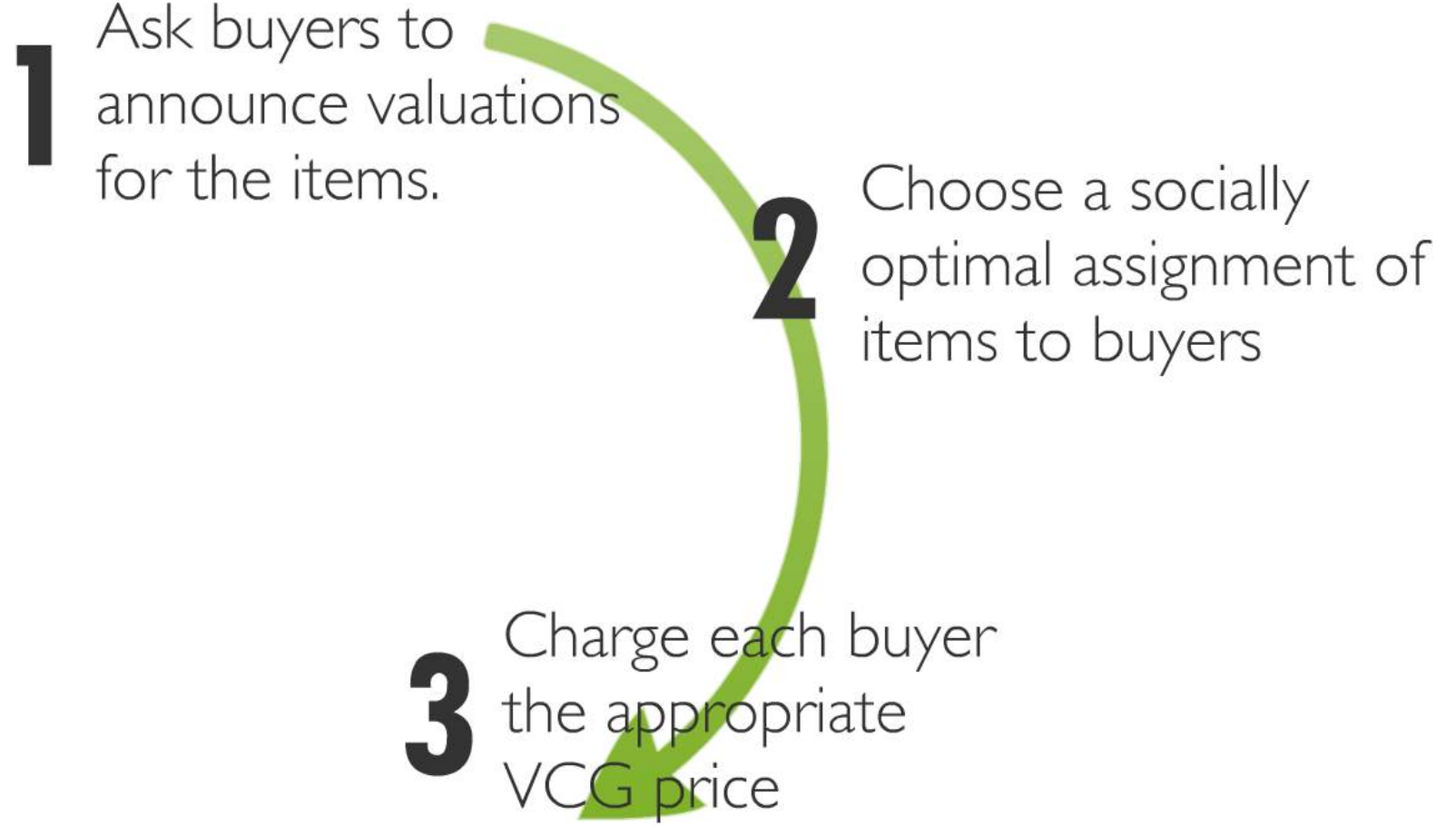
$$V_{B-j}^{S}$$

The VCG price that we charge to buyer j for item i is then:

$$p_{ij} = V_{B-j}^{S} - V_{B-j}^{S-i}$$

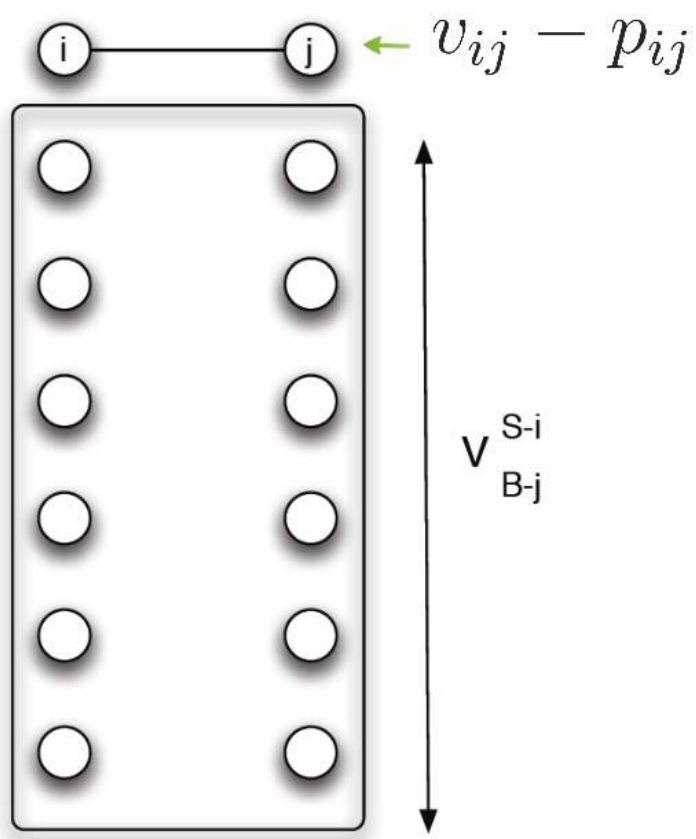
price — when j is absent — when j buys item i

the overall mechanism

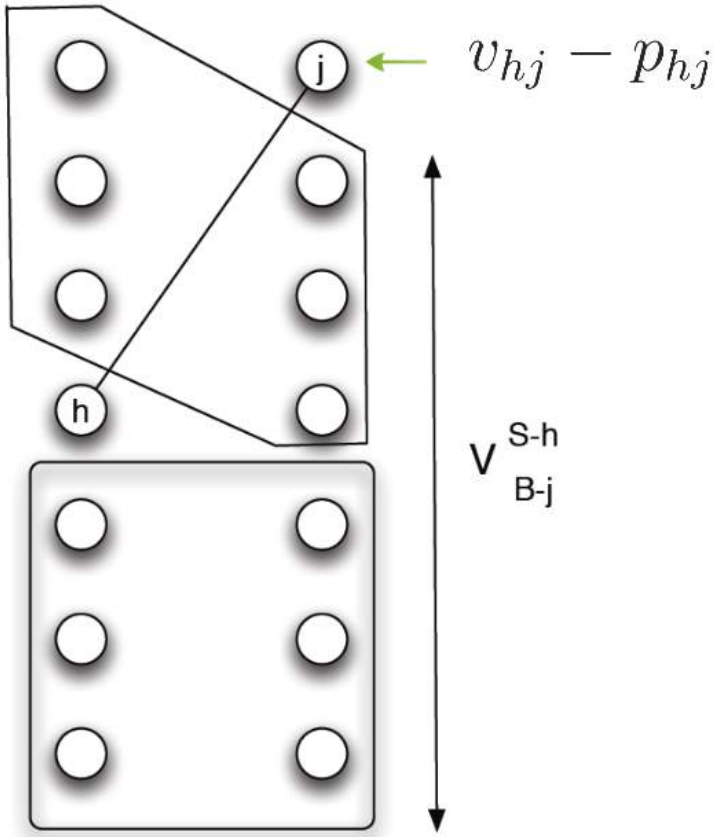


Claim: Truth telling is a dominant strategy

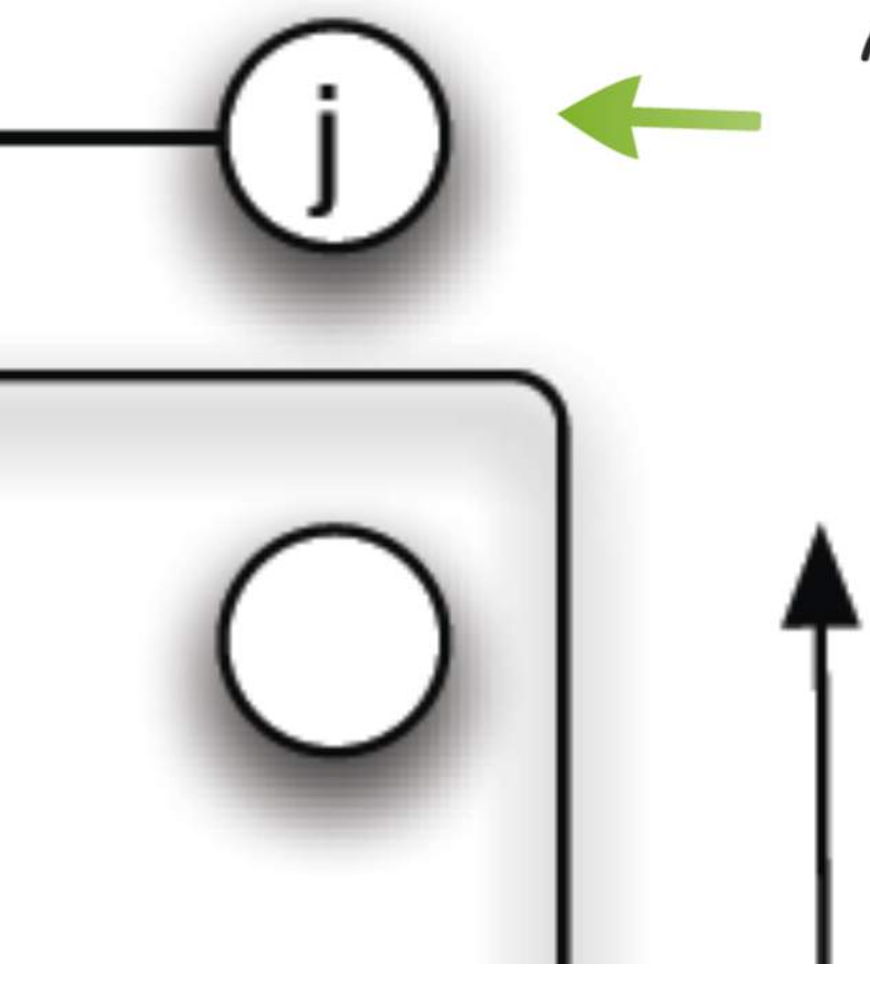
j tells the truth



j lies

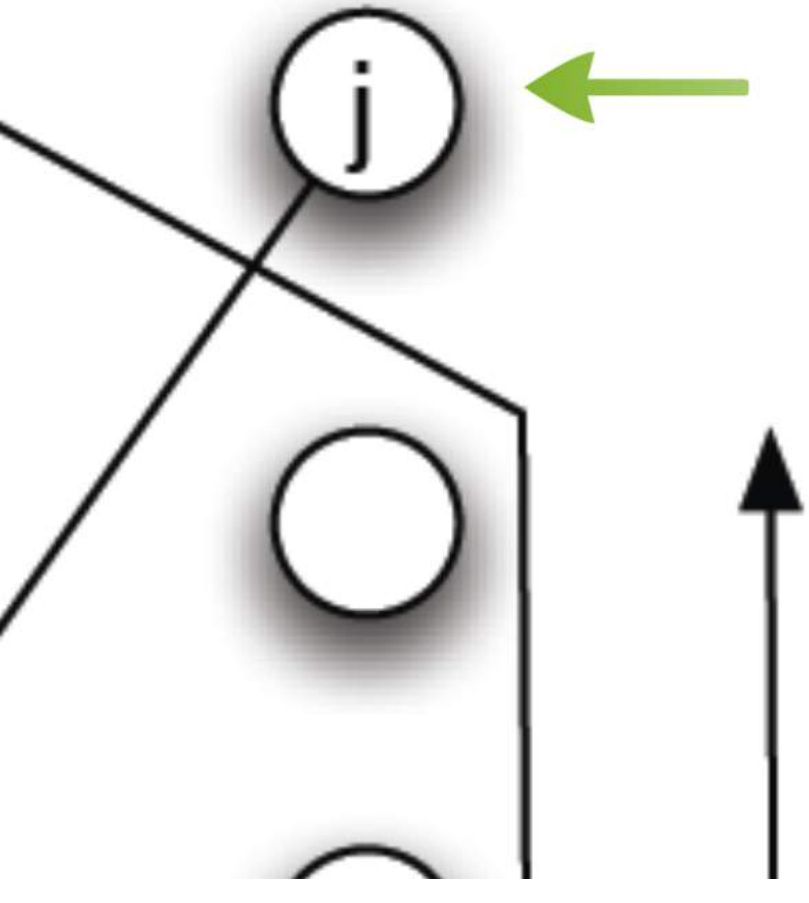


j tells the truth



$$v_{ij} - p_{ij}$$

j lies



$$v_{hj} - p_{hj}$$

what we have to show:

$$v_{ij} - p_{ij} \geq v_{hj} - p_{hj}$$

truthtelling

$$v_{ij} - [V^S_{B-j} - V^{S-i}_{B-j}] \geq \; v_{hj} - [V^S_{B-j} - V^{S-h}_{B-j}]$$

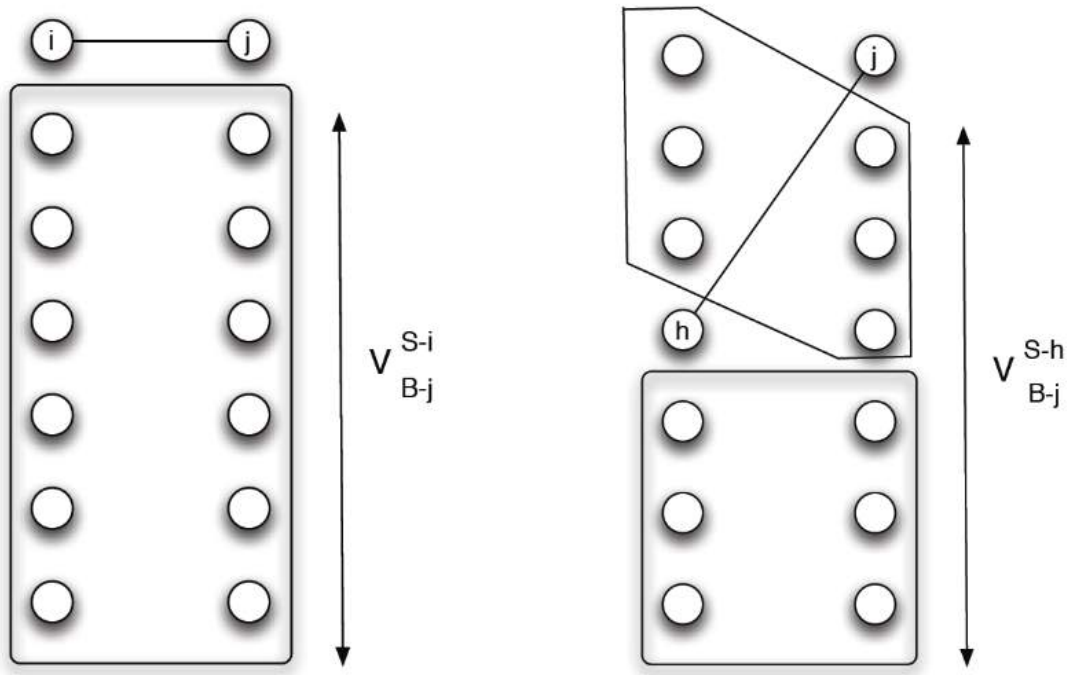
$$v_{ij} + V^{S-i}_{B-j} \geq \; v_{hj} + V^{S-h}_{B-j}$$

$$v_{ij} + V^{S-i}_{B-j} = V^S_B$$

maximum valuation
without any constraints

valuation with a constraint

$$v_{hj} + V_{B-j}^{S-h} \leq V_B^S$$



does VCG maximize seller revenue?

Each advertiser j announces a bid consisting of a single number b_j the price it is willing to pay per click

2

Then, after each advertiser submits a bid, the GSP procedure awards each slot i to the ith highest bidder, at a price per click equal to the $(i + 1)$st highest bid.

(i+1)th bid

$$r_i b_{i+1}$$

click
through rate

there can be multiple Nash equilibria

there can be multiple Nash equilibria

truth-telling may not be one of them!

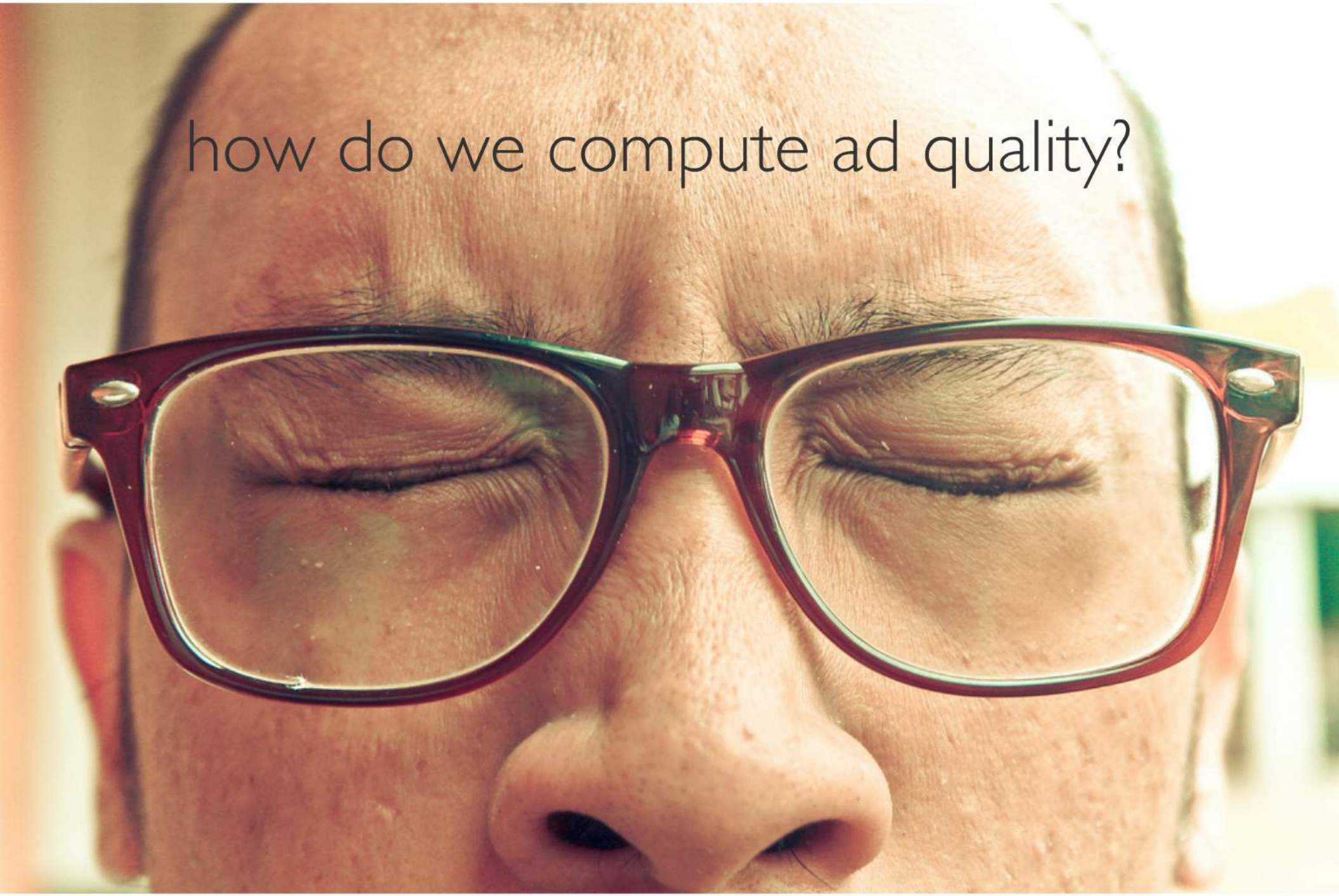
Search engine revenue can be greater than VCG, but it depends on the equilibrium!

how good is the assumption of a fixed click-through rate?

quality factor

$$v_{ij} = q_j r_i v_j$$

hidden from bidders


how do we compute ad quality?

auctions are now
more complicated!

2 Search engines now have a lot of power!