

Advertising on the Web

2017-03-18

Advertisement

“a notice or announcement in a public medium promoting a product, service, or event or publicizing a job vacancy.”

Where can I see it?



Advertising on the web

All Images Videos News Shopping More Settings Tools

About 472,000,000 results (0.61 seconds)

[Smarty.io - Automate Your FB Advertising](#)
[\[Ad\] www.smarty.io/](#) ▼
Scale & automate your social media **advertising** easily with Smarty. Learn more!
Highlights: Offer A 14-Day Free Trial, No Minimum Contract Period, Eliminate Manual Tasks...
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[Online advertising - Wikipedia](#)
https://en.wikipedia.org/wiki/Online_advertising/ ▼
Jump to **Web banner advertising** · Web banners or banner ads typically are graphical ads displayed within a web page. Many banner ads are ...
[History](#) · [Delivery methods](#) · [Compensation methods](#) · [Benefits of online advertising](#)

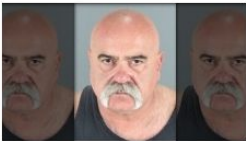
[5 Things You Must Do Before Jumping Into Paid Internet Advertising](#)
<https://blog.kissmetrics.com/paid-internet-advertising/> ▼
Paid advertising is a great way to guide more traffic to your site, but it can become ... Finally, the best source of keywords can come from your own website.


[How Web Advertising Works | HowStuffWorks](#)
computer.howstuffworks.com/web-advertising.htm ▼
The second trend is true of nearly all commercial Web sites. There are many new forms of Web advertising, and they are more and more obvious. Many Web ...


Where can I see it?

FOX NEWS Home Video Politics U.S. Opinion Business Entertainment Tech Science Health Travel Lifestyle World On Air



Caring for your gestational diabetes



Man accused of posing as dentist allegedly cooked meth in office



Pilot donates life-saving kidney to flight attendant



Dangerous 'Eraser Challenge' sees kids rubbing skin off arms while reciting alphabet

Sponsored Stories Ad Content by Outbrain



Goldie Hawn and Kurt Russell's Longtime Pacific...
Sponsored | Mansion Global



They're Not All Democrats: 25 Republican Celebrities
Sponsored | PrettyFamous | By Graphiq



25 Names Nobody Wants to Name Their Kid Anymore
Sponsored | MooseRoots | By Graphiq



Justin Bieber Joins London's Wealthy on Billionaire's Row
Sponsored | Mansion Global

Don't miss...


How to host like a real housewife with Kristen Carroll Taekman


Will New CEO Make Jessica Alba's Billion Dollar Startup...


Photographer's Daughter Inherits 100,000 Baby Pictures


How to Avoid the 10 Most Common Kitchen Design...

Where can I see it?

The image is a screenshot of a Facebook homepage. At the top, there is a search bar with the text "Wyszukaj osoby, miejsca i inne" and a magnifying glass icon. To the right of the search bar, there are icons for "Strona główna", a profile picture, a speech bubble, a globe, and a question mark.

Below the search bar, there are three main sections:

- Left Sidebar:** Contains navigation links: "Aktualności" (with three dots), "Messenger", "SKRÓTY" (with a list of icons and "20+" next to each), "EKSPLORUJ" (with a calendar icon and "1 Wydarzenia"), "Listy znajomych", "Aktualności ze stron" (with "20+" next to it), "Zaczepek" (with "2" next to it), and "Zobacz więcej...". At the bottom of the sidebar, there is a section "UTWÓRZ" with links for "Reklama", "Strona", "Grupa", and "Wydarzenie".
- Center Feed:** Starts with a "Proponowany post" (Proposed post) from "SWIX" (Sponsorowane). The post is titled "SWIX NERO Universal Racing Klister" and includes a link "Zobacz tłumaczenie". It features two images: a skier in a blue suit and a hand holding a black ski wax stick. Below the images are two buttons: "Kup teraz" (Buy now) and "Reduserer risiko for ising". At the bottom of the post, it shows "324" likes, "8 komentarzy" (8 comments), and "3 udostępnienia" (3 shares).
- Right Sidebar:** Contains a section "1 zaproszenie na wydarzenie" (1 invitation to an event). Below it is a section "Utwórz reklamę" (Create an ad) featuring a group of five men. Below that is an advertisement for "foraas.no" with the text "Salgsleder • Elektro/Mekanisk monter fremobemannings.no" and "Foraas Områdesikring AS er i vekst og søker nye medarbeidere!". At the bottom of the right sidebar, there is a language selection menu with options: "Polski", "English (US)", "Norsk (bokmål)", "Norsk (nynorsk)", and "Español".

Two large blue arrows are overlaid on the image: one pointing from the "Wydarzenia" link in the left sidebar towards the center feed, and another pointing from the right sidebar towards the center feed.

Where can I see it?

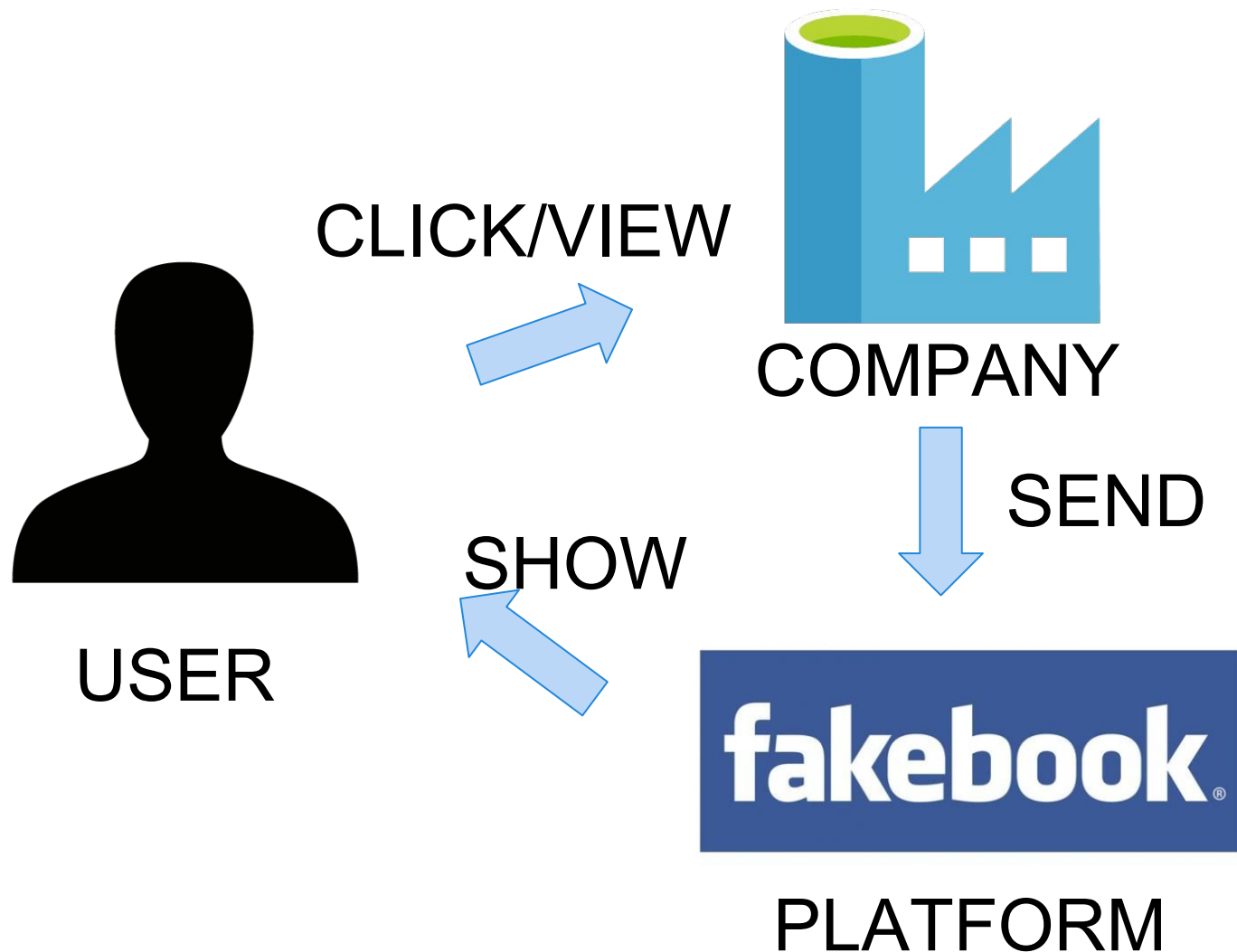
- does not matter what do you do
- in what language
- on which site

ads are
EVERYWHERE

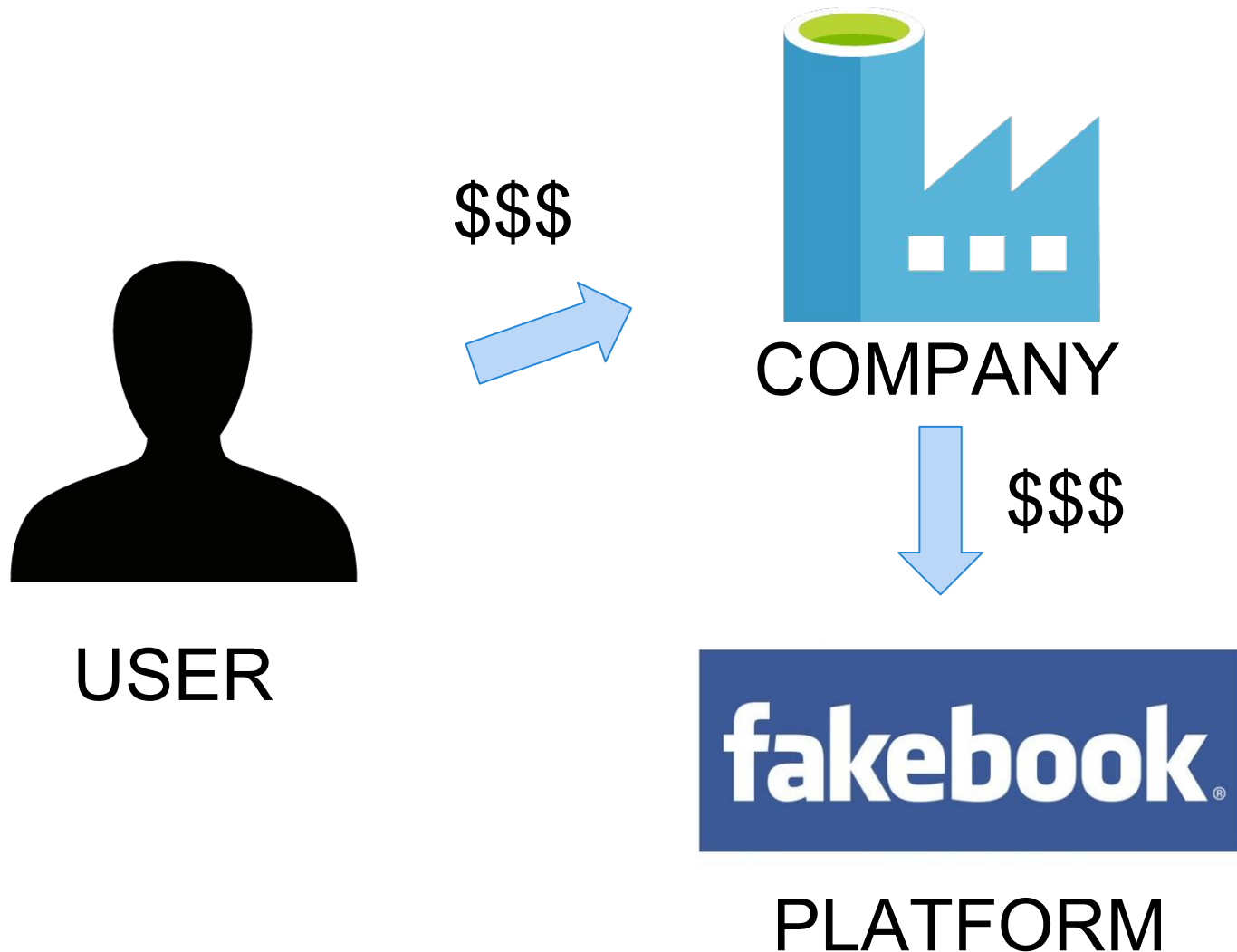
Why?

**Google's total advertising revenues of
USD \$43.7 billion in 2012**

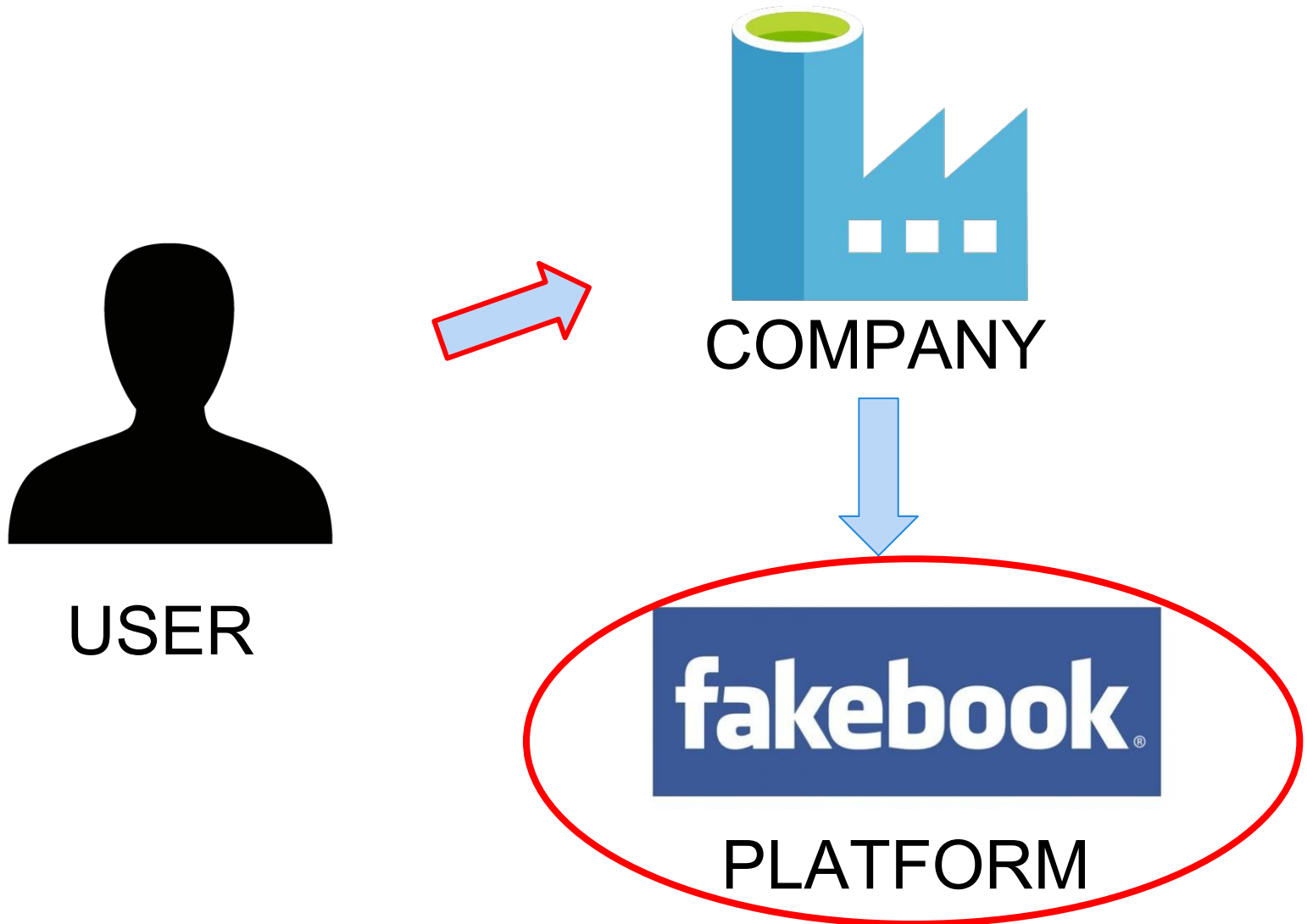
Setting: three sides - advert flow



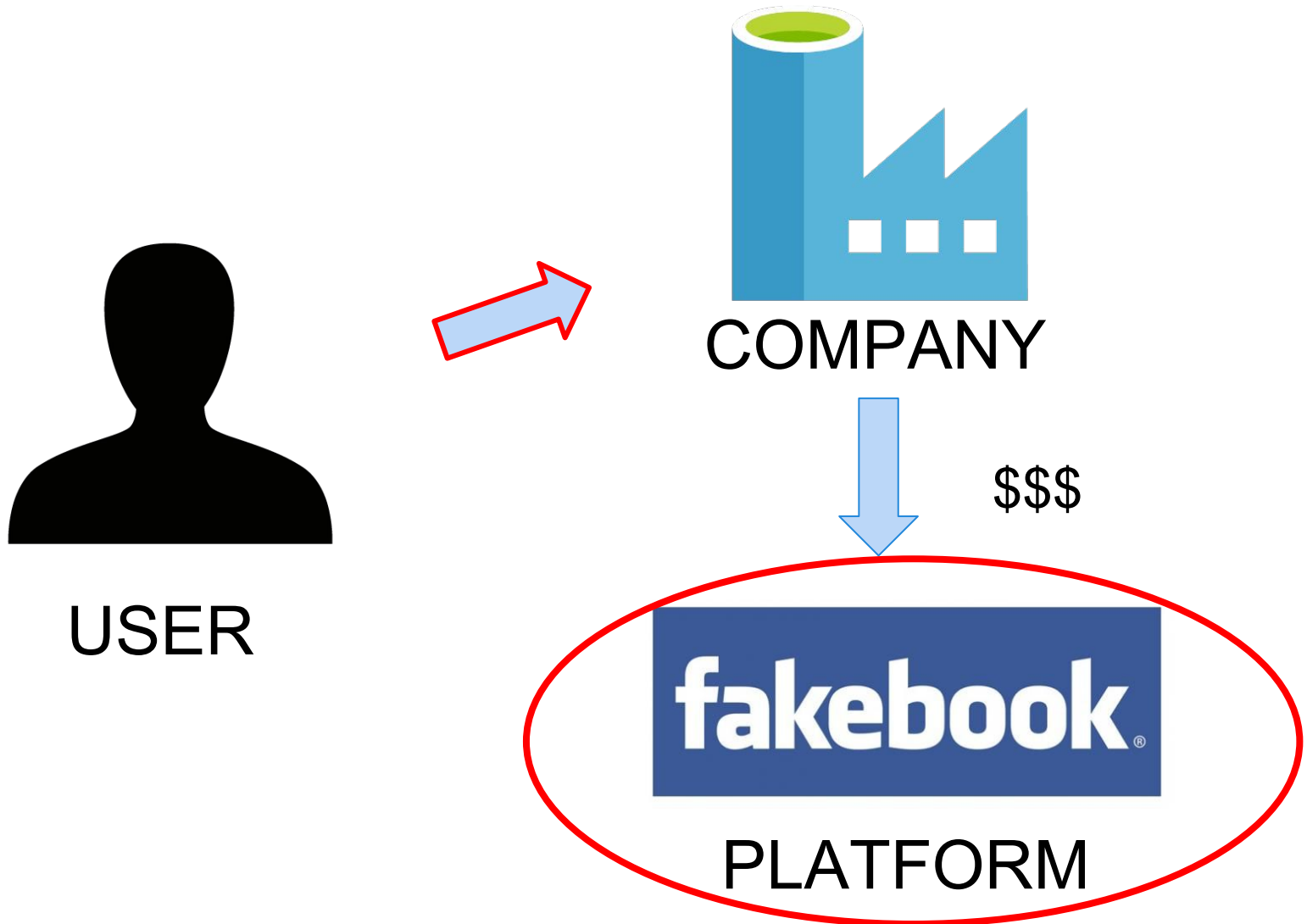
Setting: three sides - money flow



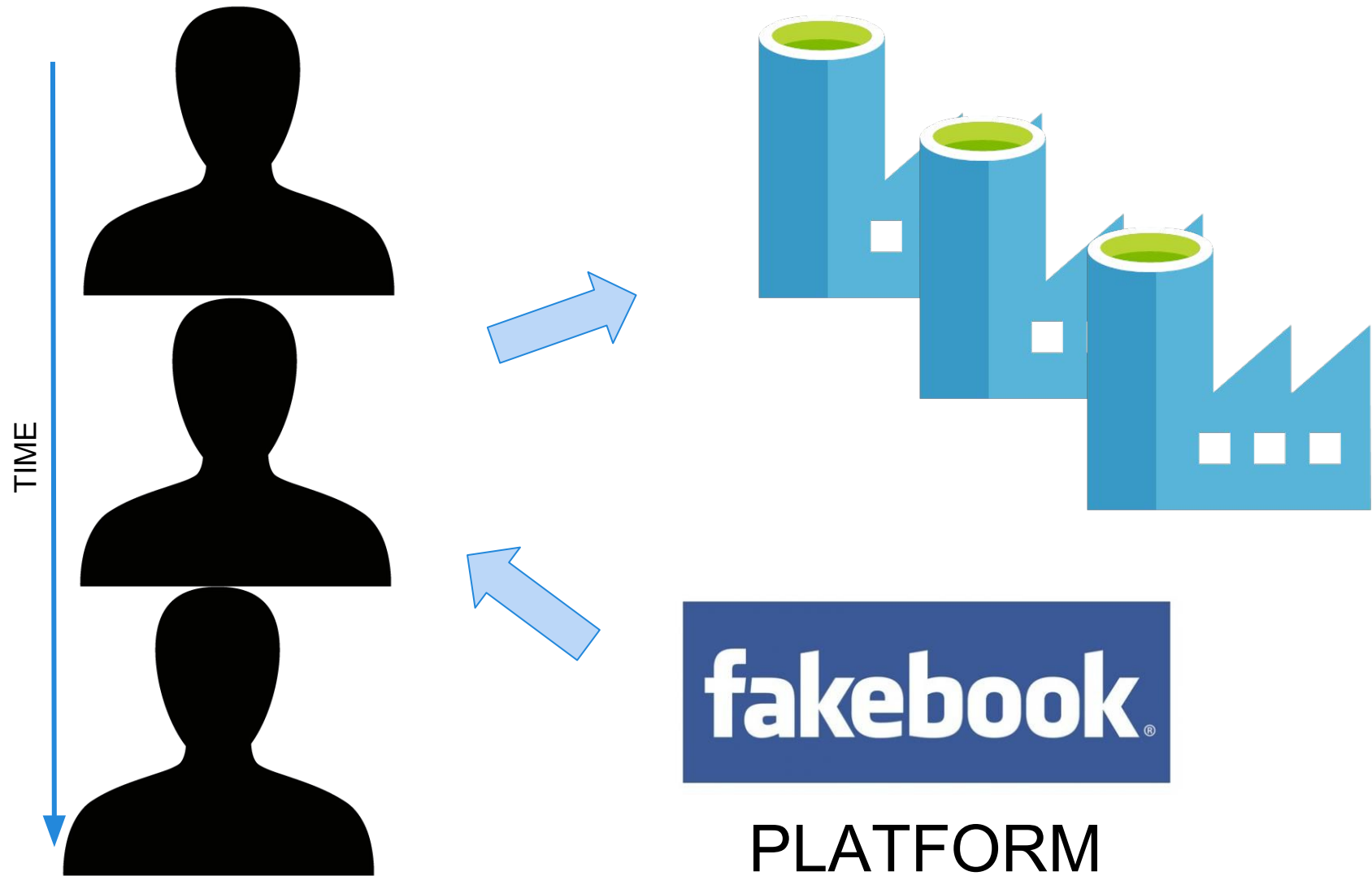
Setting: Where are we?



Setting: What do we want?



Setting: We forgot about TIME



Revenue

How much do we (as a platform) earn from our matching?:

- **per impression**
- **per click**

Adwords model

- **Given:**
 - 1. A set of bids by advertisers for search queries
 - 2. A click-through rate for each advertiser-query pair
 - 3. A budget for each advertiser (say for 1 month)
 - 4. A limit on the number of ads to be displayed with each search query
- **Respond to each search query with a set of advertisers such that:**
 - 1. The size of the set is no larger than the limit on the number of ads per query
 - 2. Each advertiser has bid on the search query
 - 3. Each advertiser has enough budget left to pay for the ad if it is clicked upon

Only ~1 impression per 100 is clicked: CTR

Advertiser	Bid	CTR	Bid * CTR
A	\$1.00	1%	1 cent
B	\$0.75	2%	1.5 cents
C	\$0.50	2.5%	1.125 cents

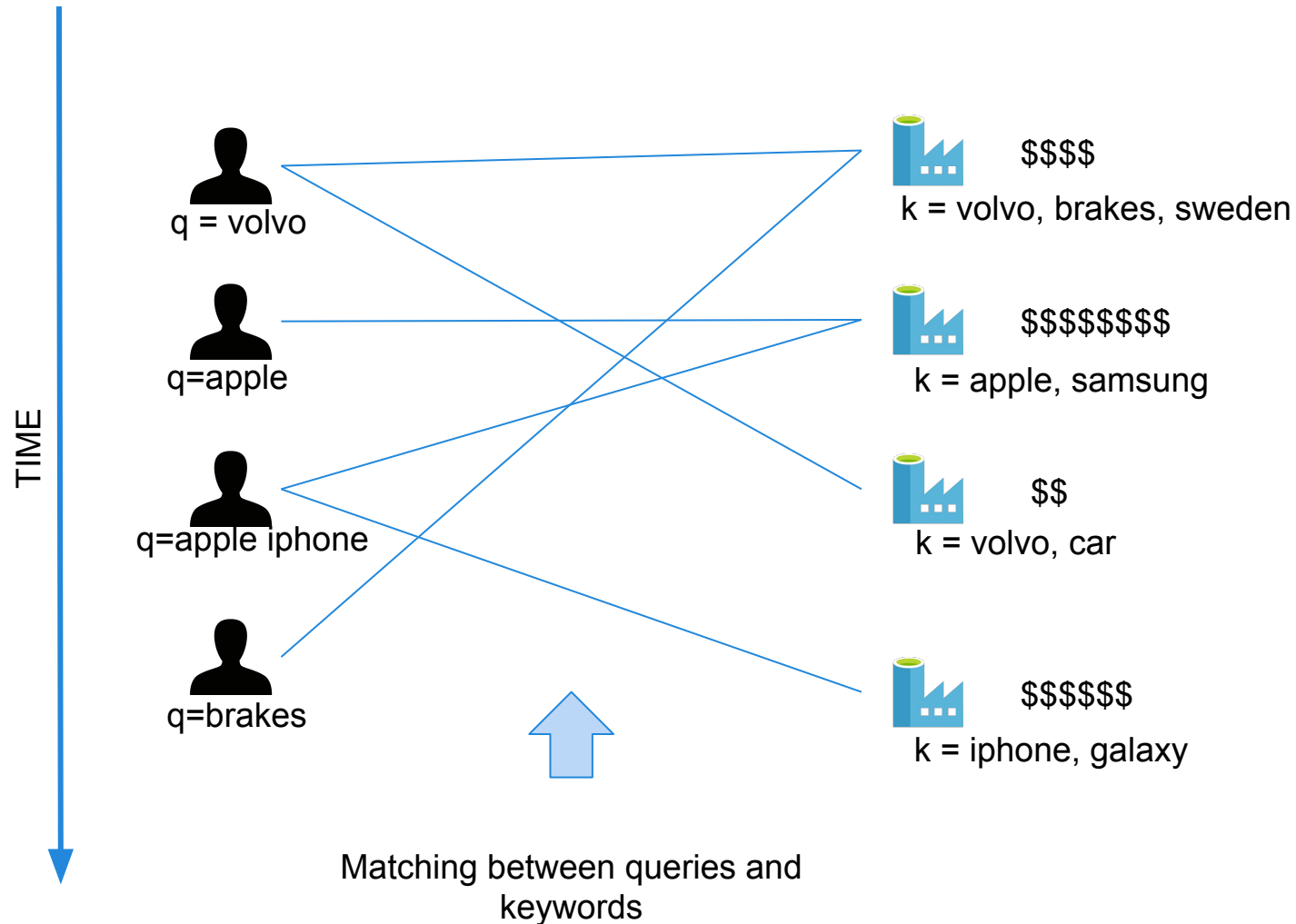
Click through
rate

Expected
revenue

Simplifications

- Each user has one advert slot
 - If he has more we can just repeat the ad selection for each of them sequentially
- Every advert has the same expected revenue

Adwords model



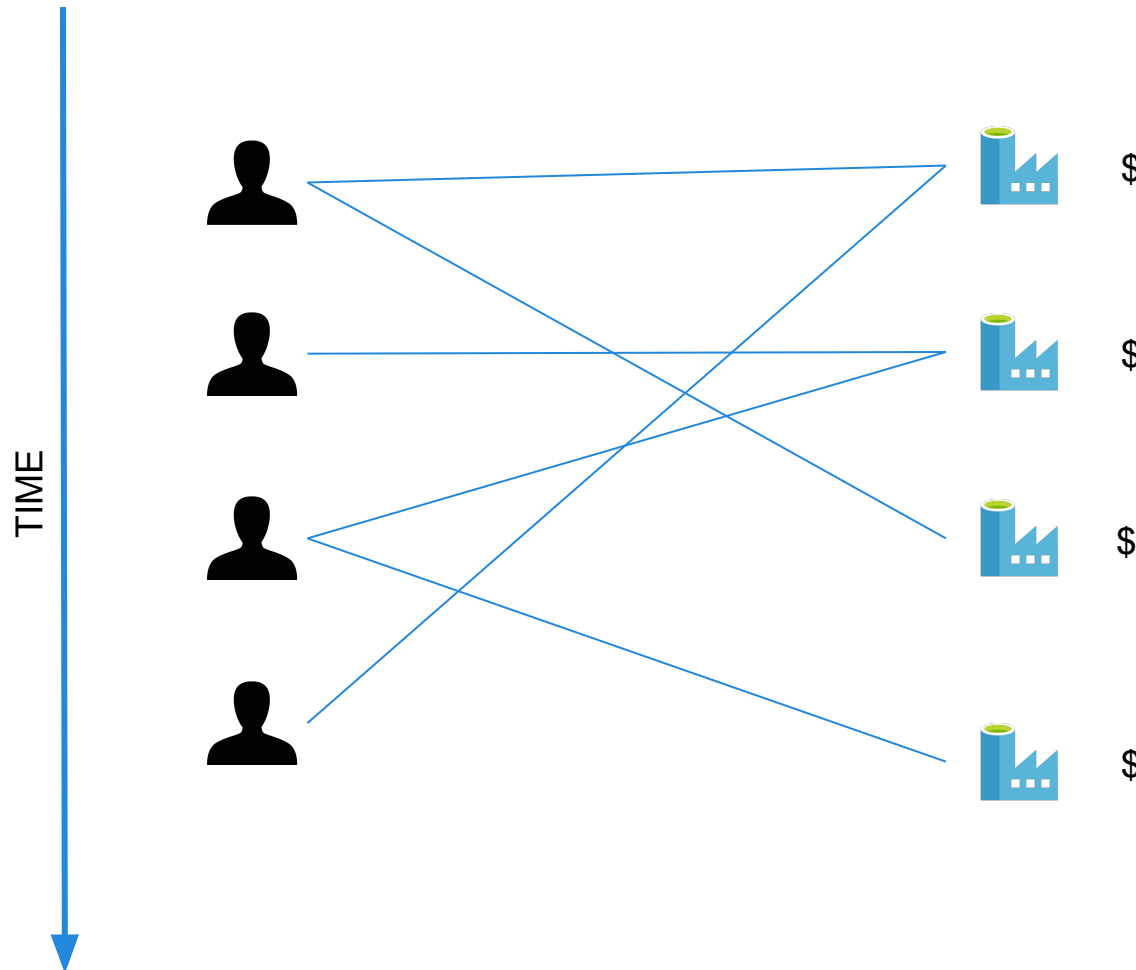
Greedy algorithm

For a query pick any advertiser who has bid for that query.

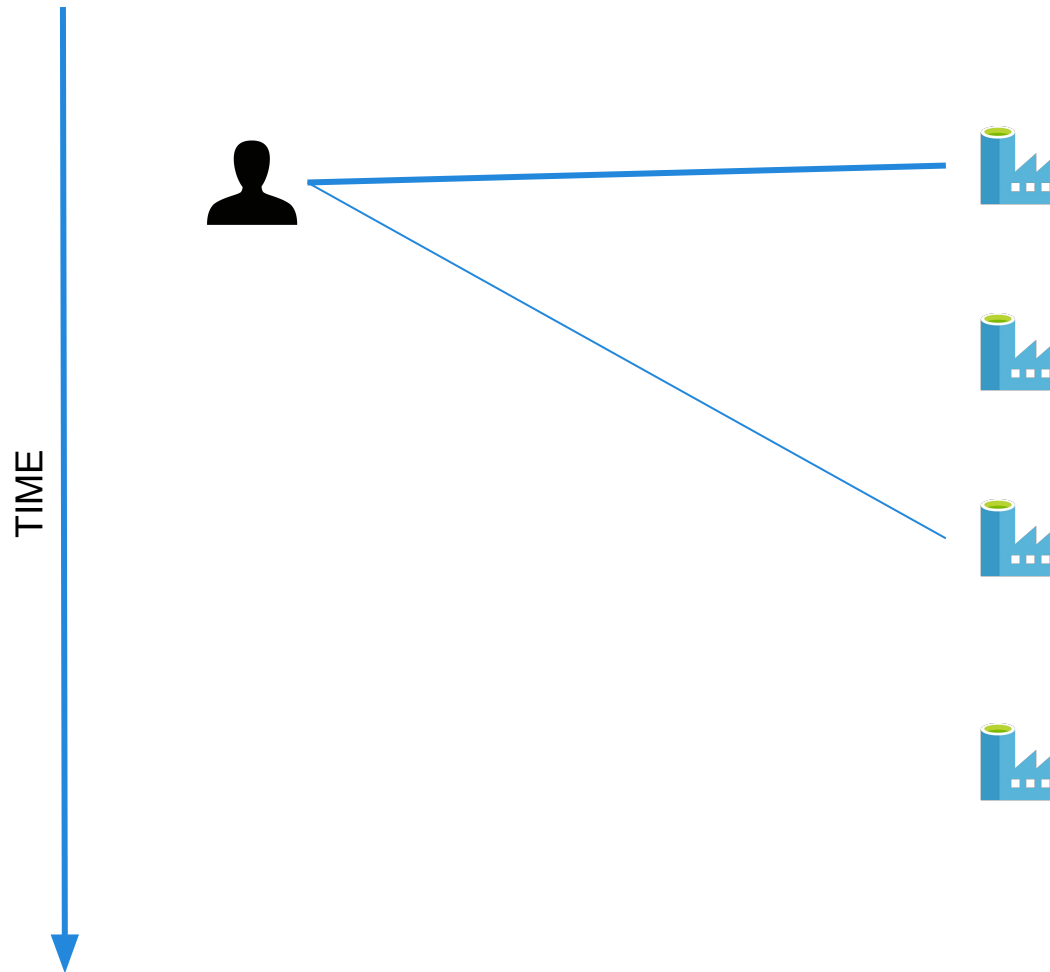
(Few possibilities in when there are several bidders.)

Simple Greedy with everybody having 1\$

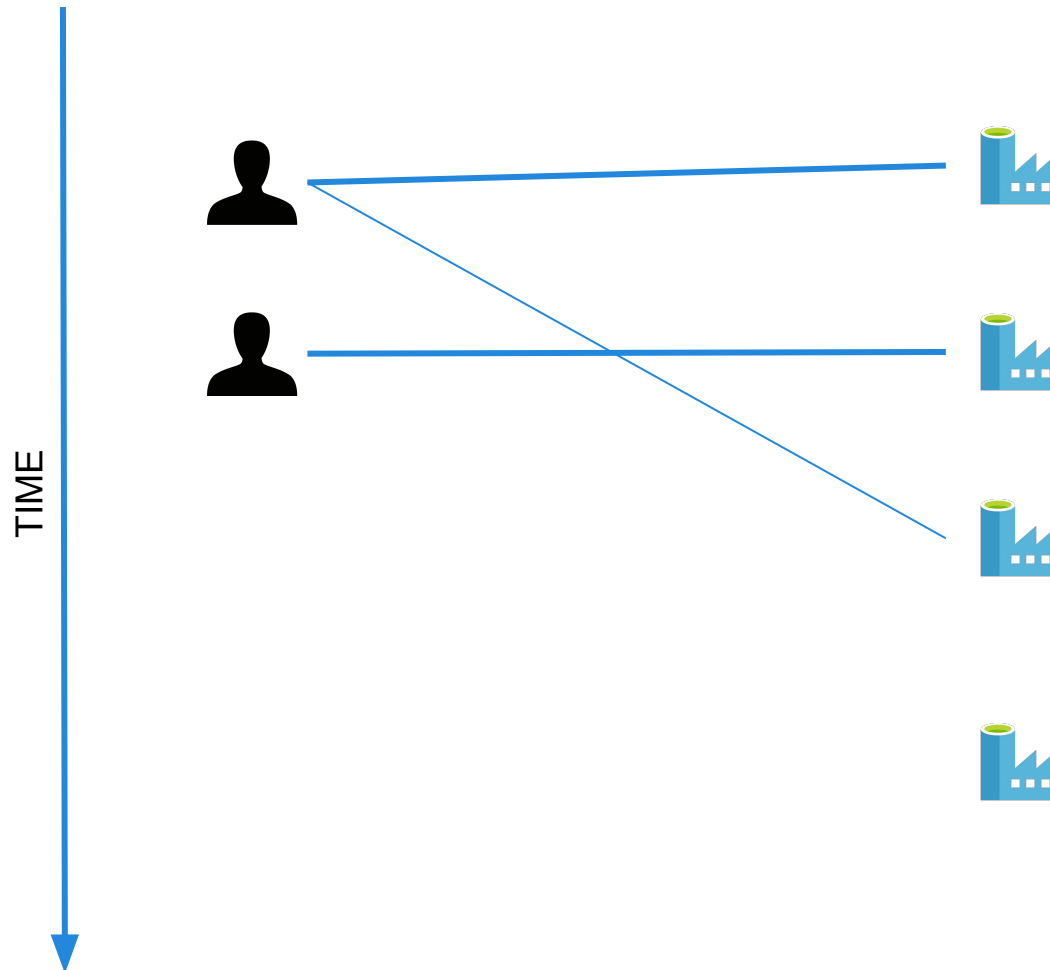
Matching 1: everybody has 1\$



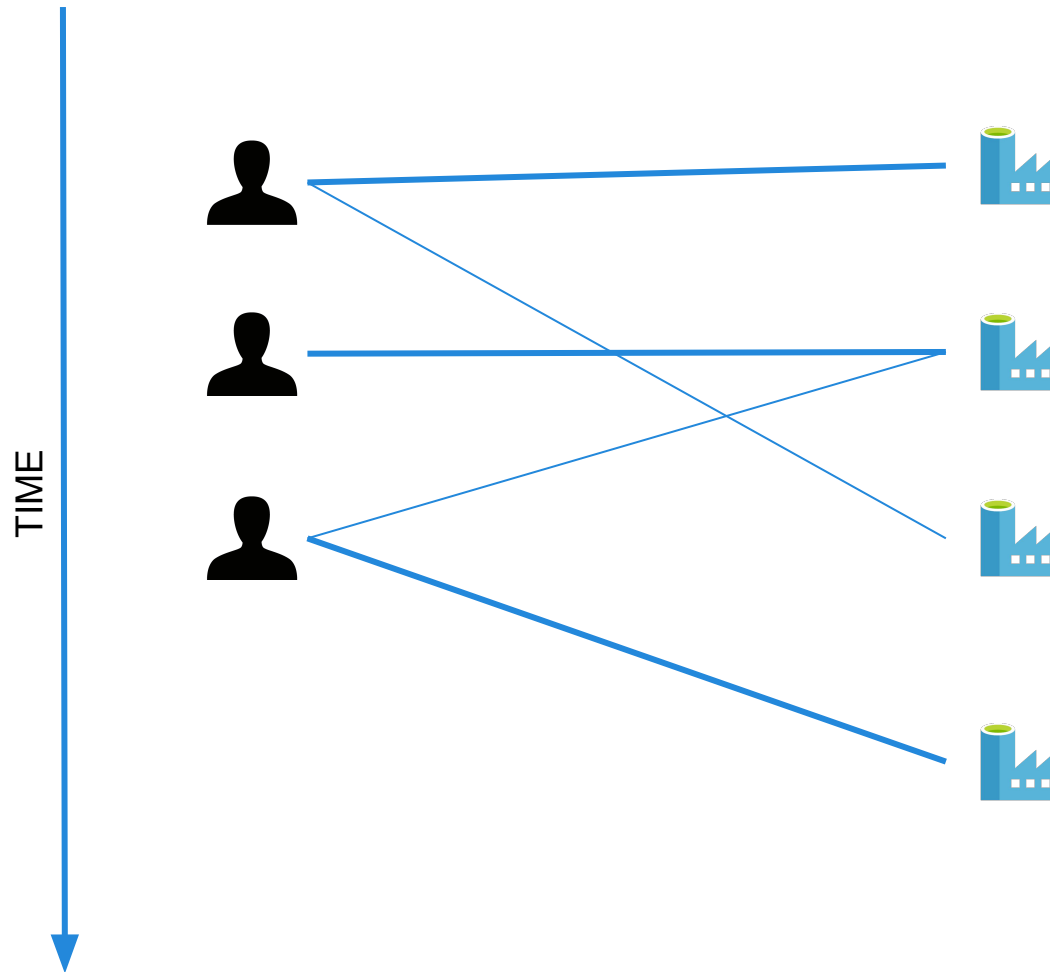
Online Greedy Matching



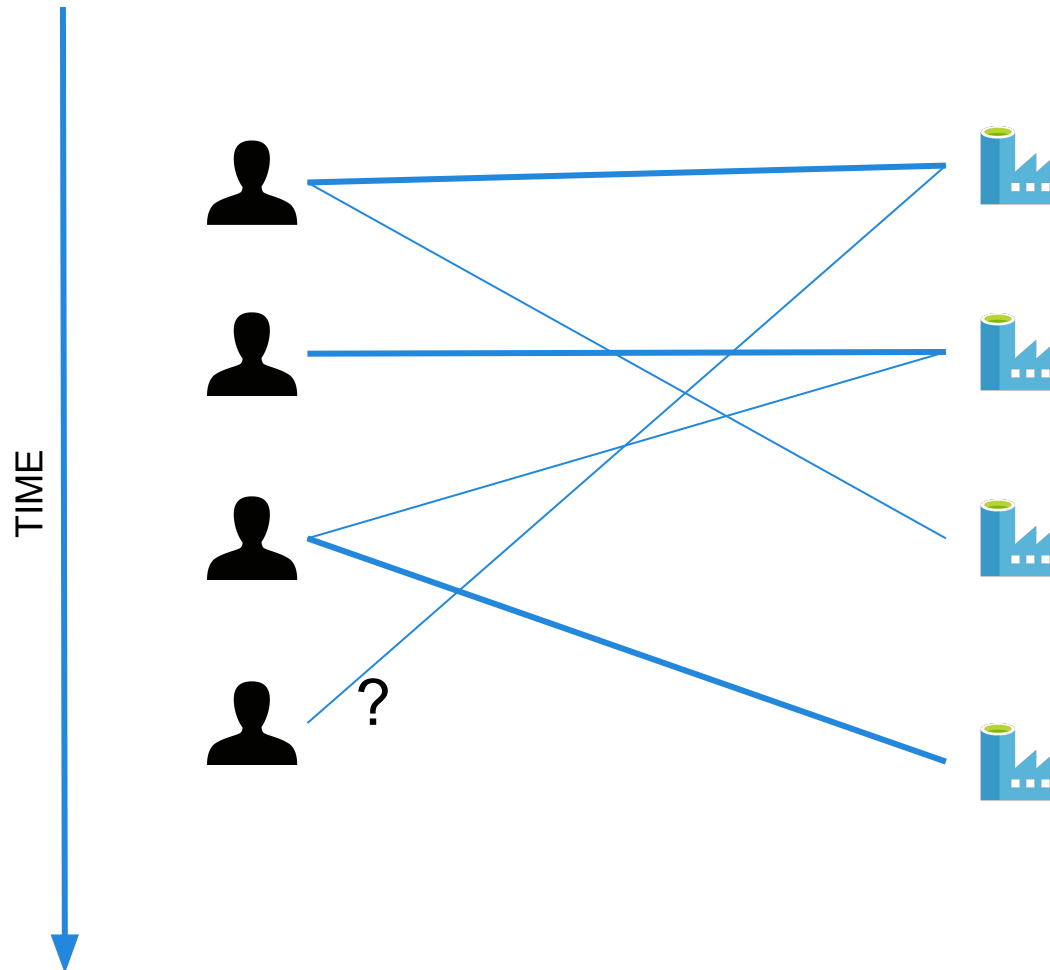
Online Greedy Matching



Online Greedy Matching

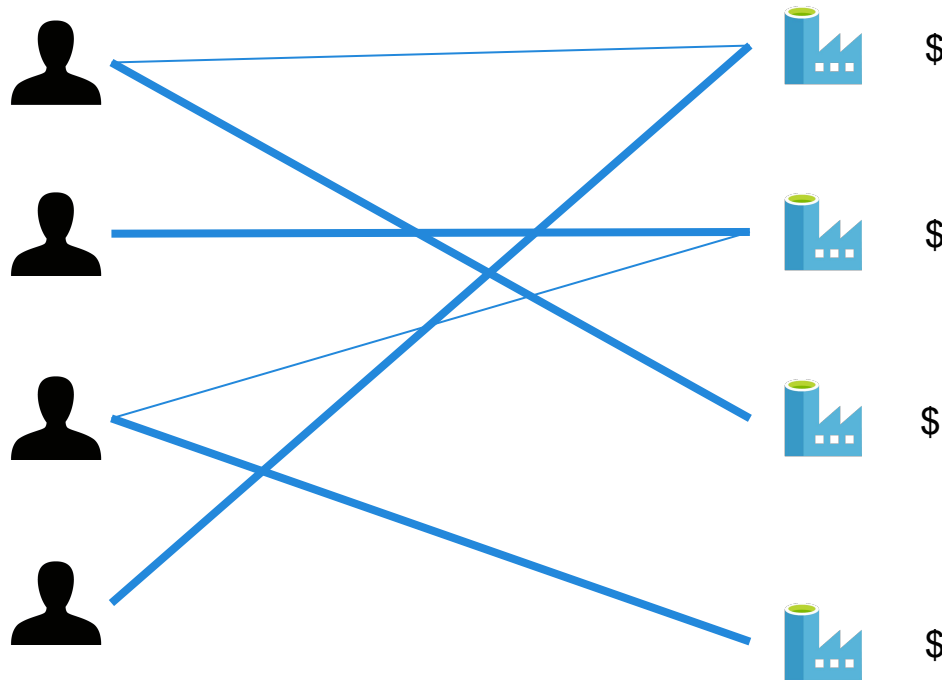


Online Greedy Matching

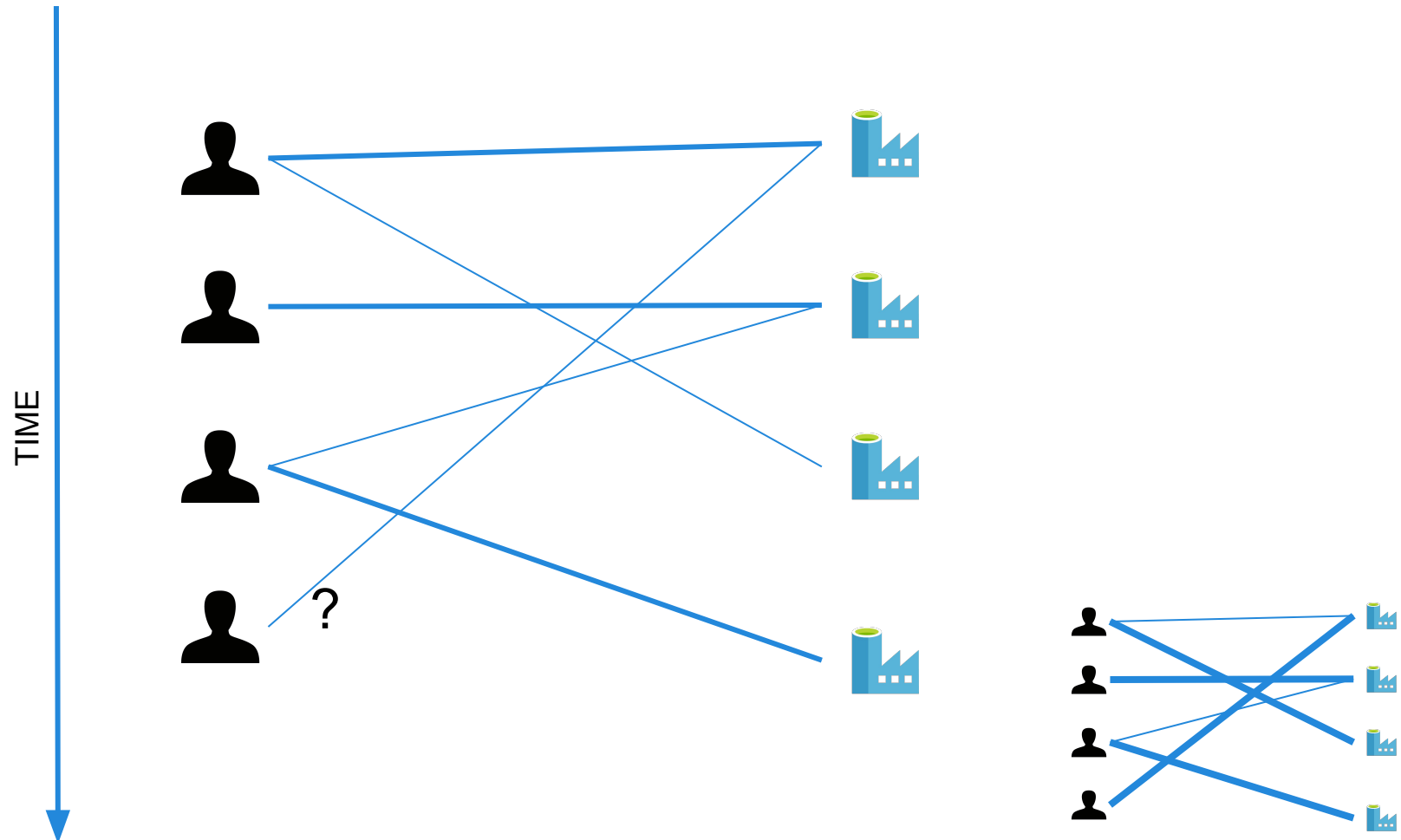


What's the perfect matching?

Perfect Matching



Online Greedy Matching



Greedy with 2 companies (bidders) with 3\$

Remark: on plots we skip lines representing possible matchings (that can be inferred from keywords overlapping)

Adwords (simplified: $k=1$) model

TIME



\$\$\$

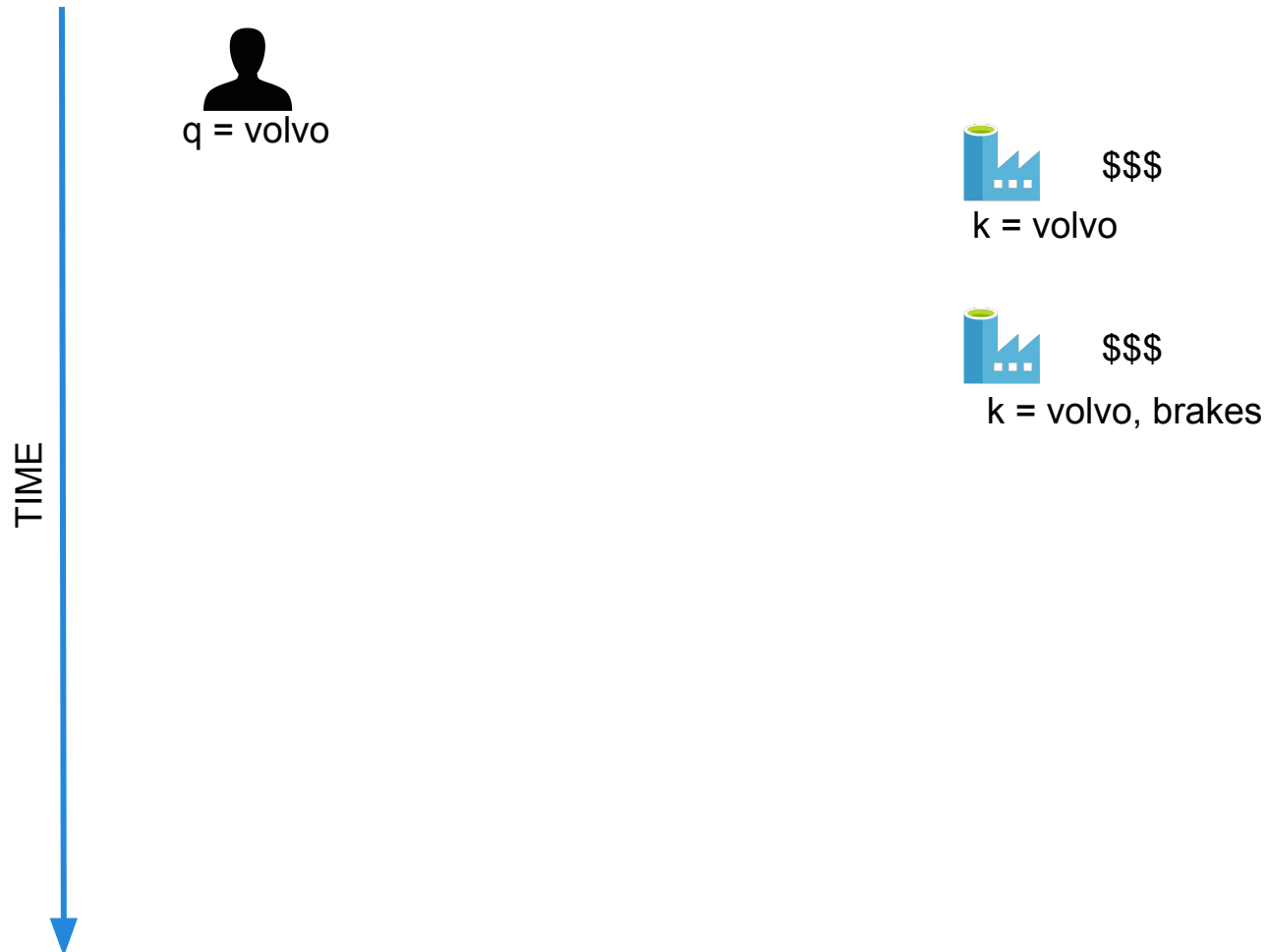
$k = \text{volvo}$



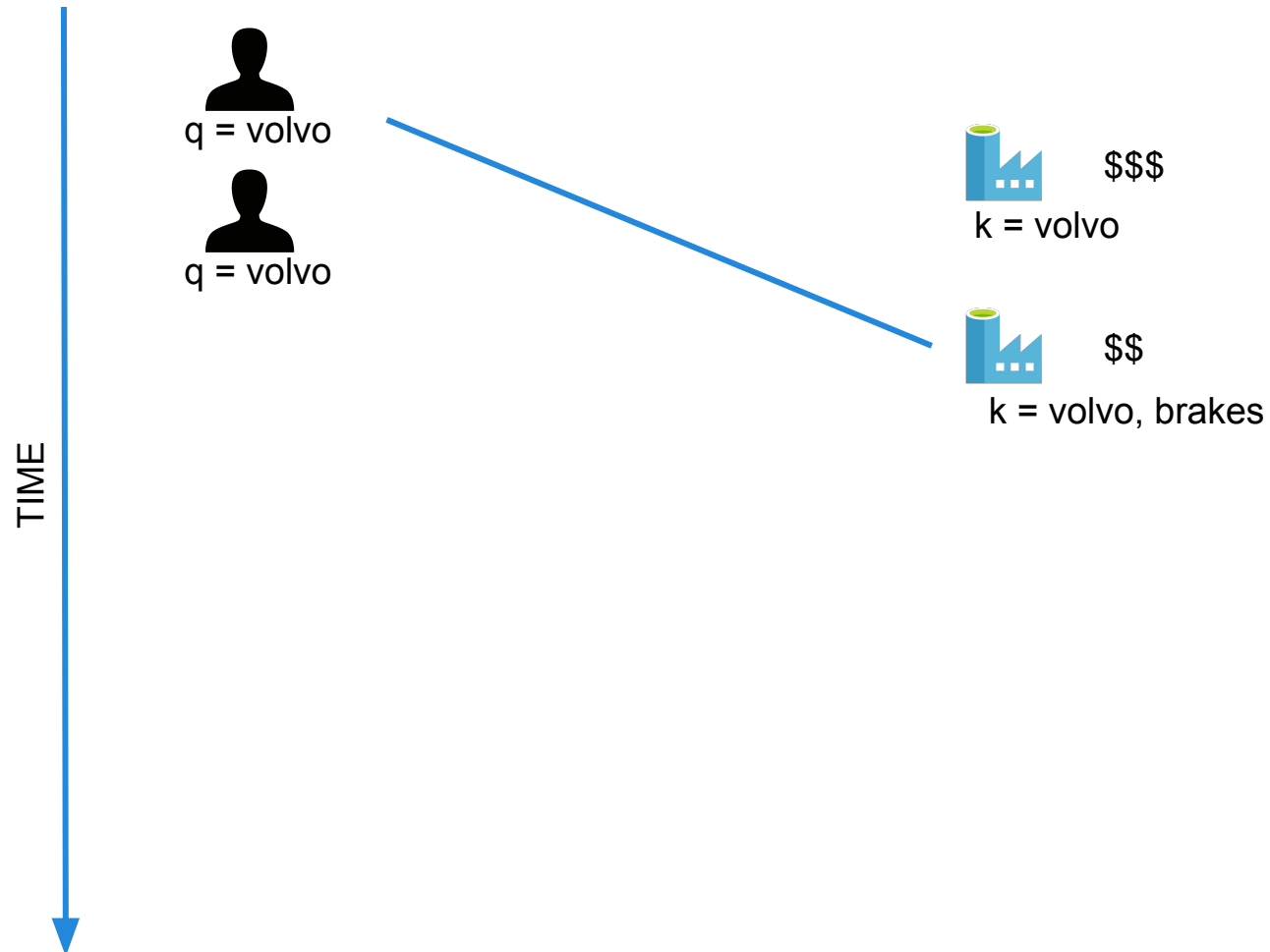
\$\$\$

$k = \text{volvo, brakes}$

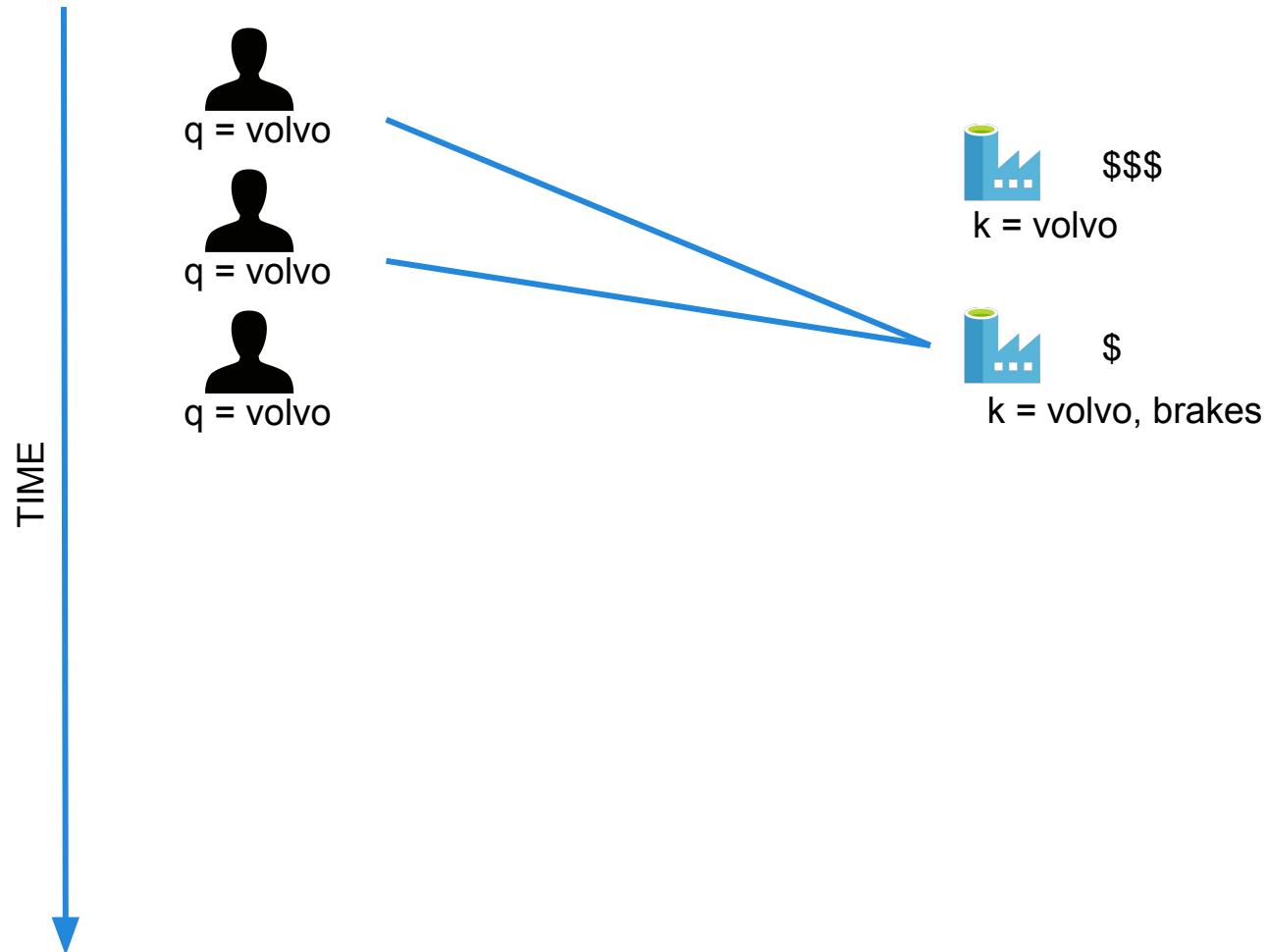
Adwords (simplified: $k=1$) model



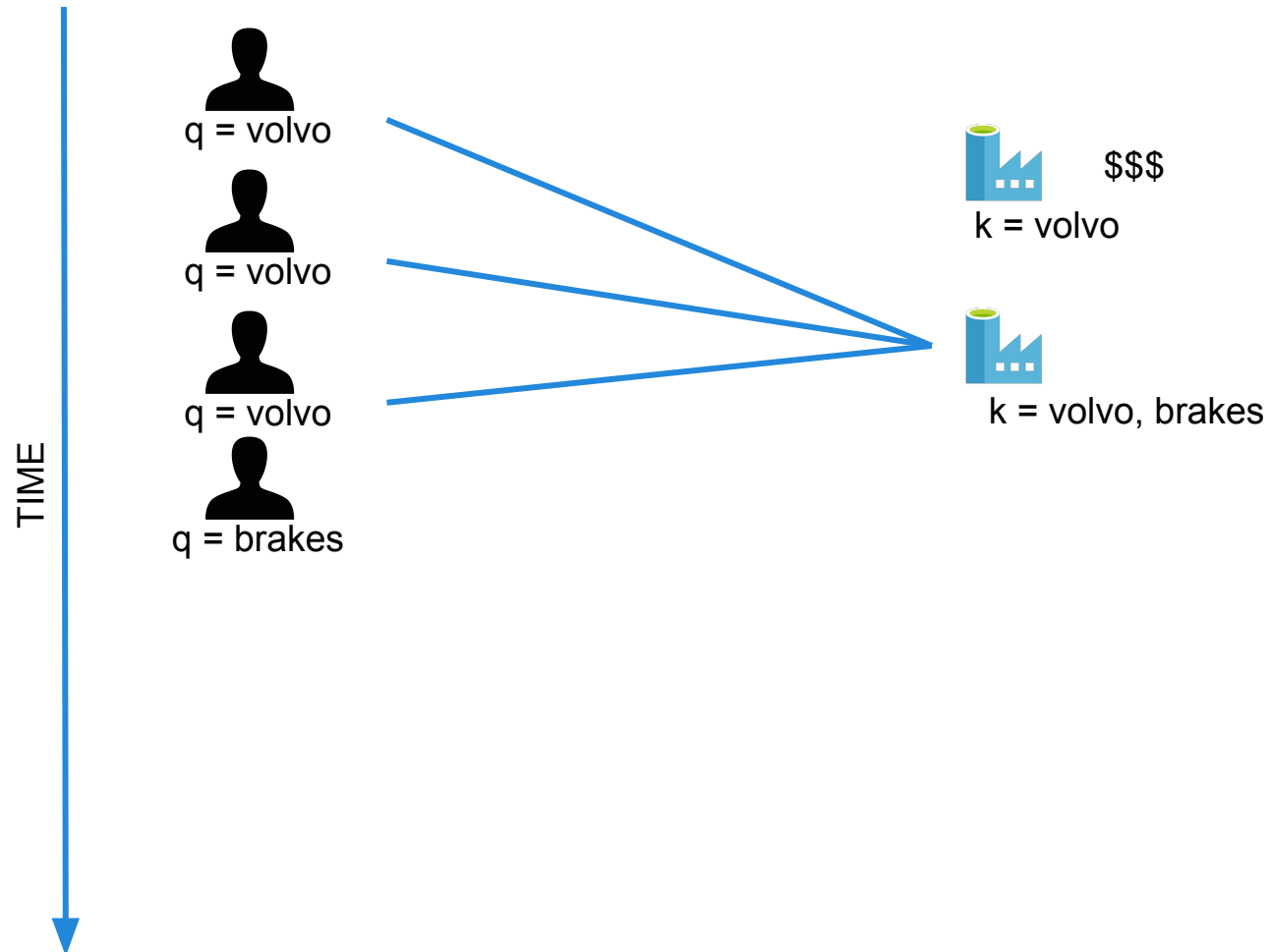
Adwords (simplified: $k=1$) model



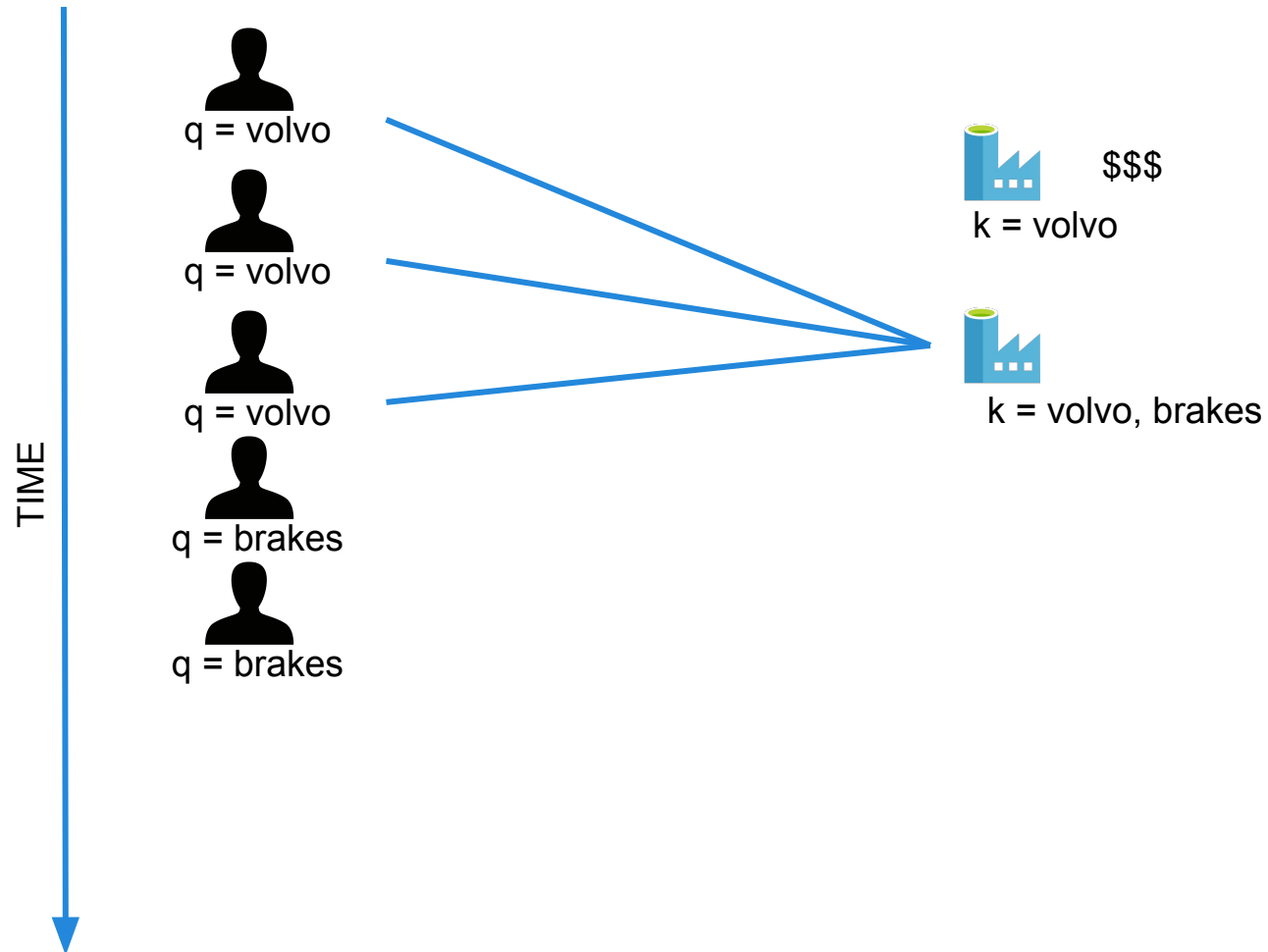
Adwords (simplified: $k=1$) model



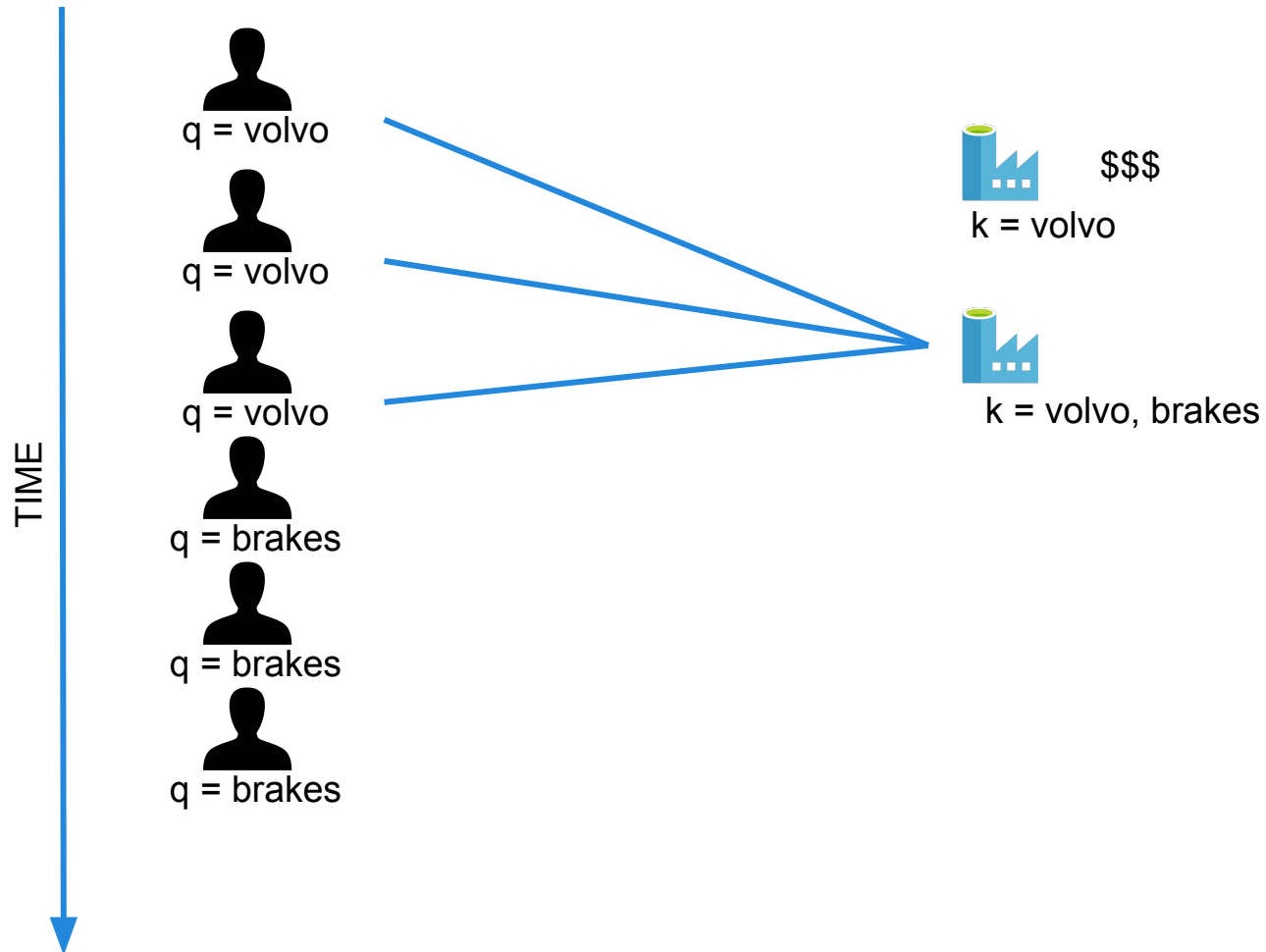
Adwords (simplified: $k=1$) model



Adwords (simplified: $k=1$) model

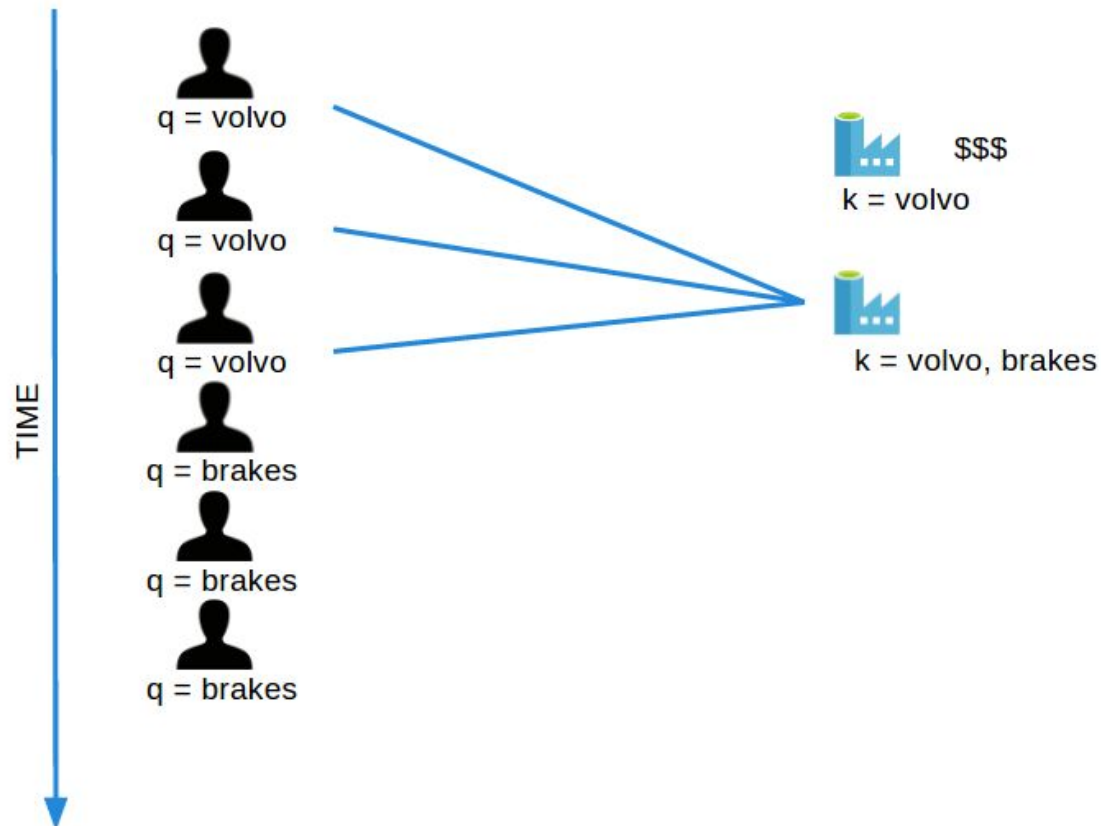


Adwords (simplified: $k=1$) model



Revenue

We could earn 6\$ but we earned only 3\$



Revenue

**Better algorithm M ->
More matches ->
Higher Revenue**

Competitiveness

- For input I , suppose greedy produces matching M_{greedy} while an optimal matching is M_{opt}

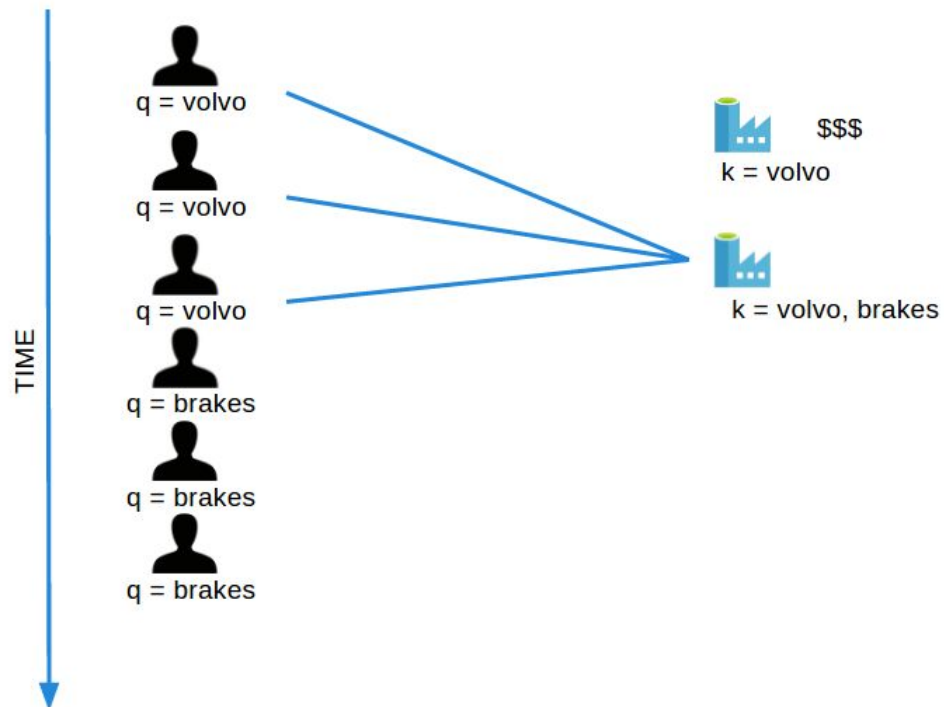
Competitive ratio =

$$\min_{\text{all possible inputs } I} (|M_{greedy}| / |M_{opt}|)$$

(what is greedy's worst performance over all possible inputs I)

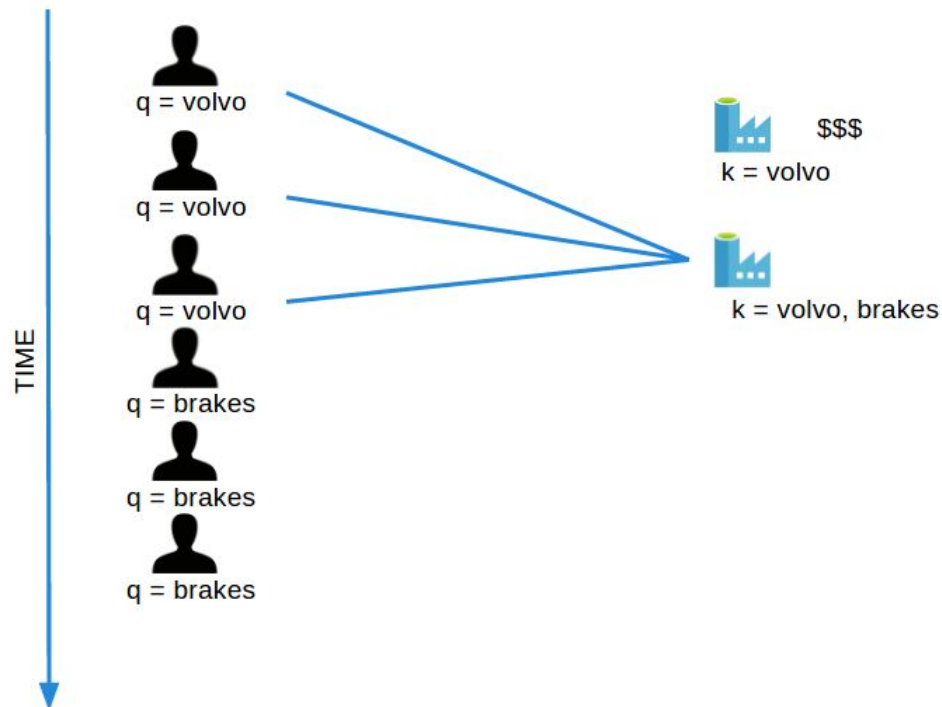
Competitiveness

For this data we matched $3/6 = 1/2$

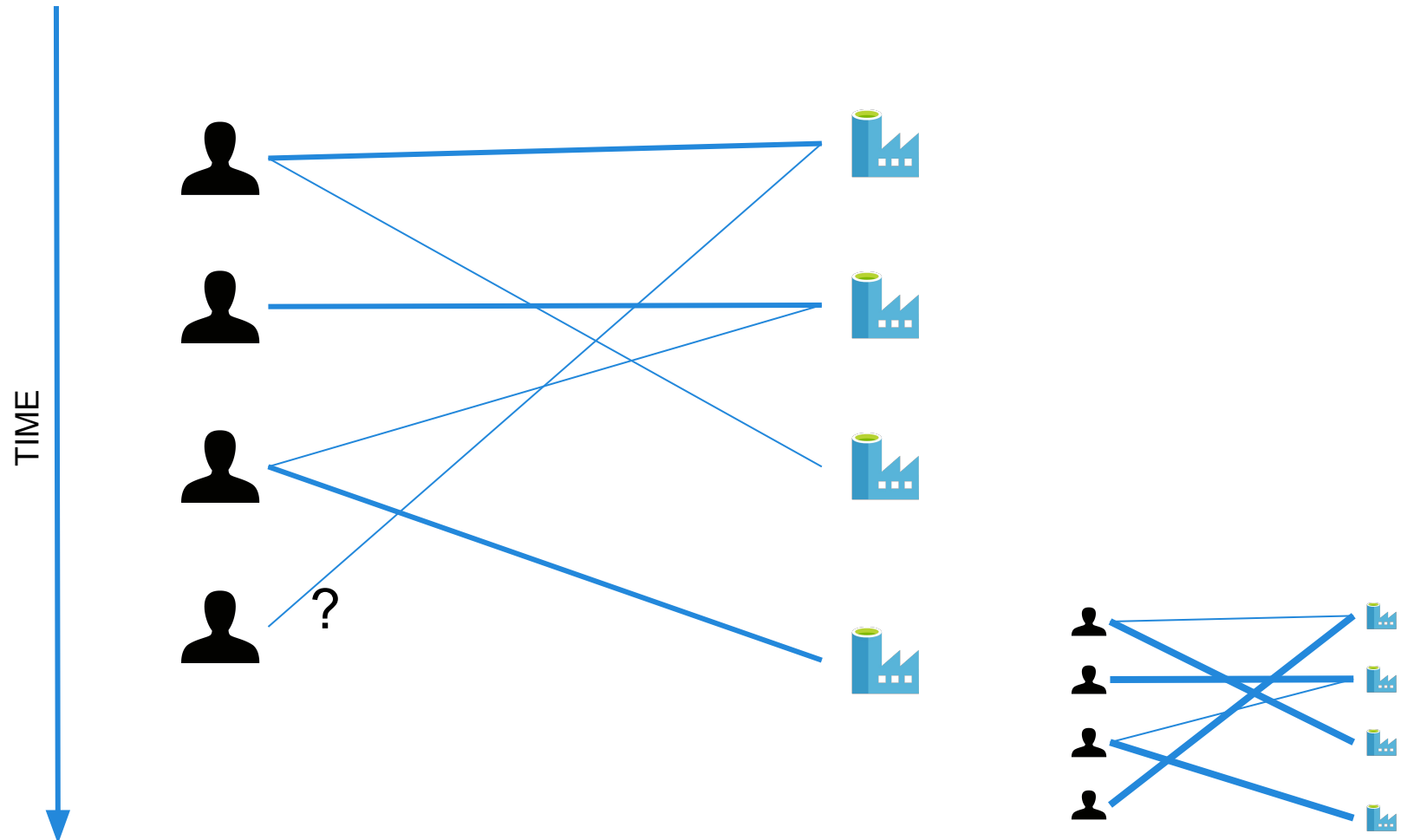


Competitiveness

Actually it's the worst scenario: (under our simplifications) competitive ratio for the greedy algorithm(s) is $1/2$ (in general, not only here)



Online Greedy Matching

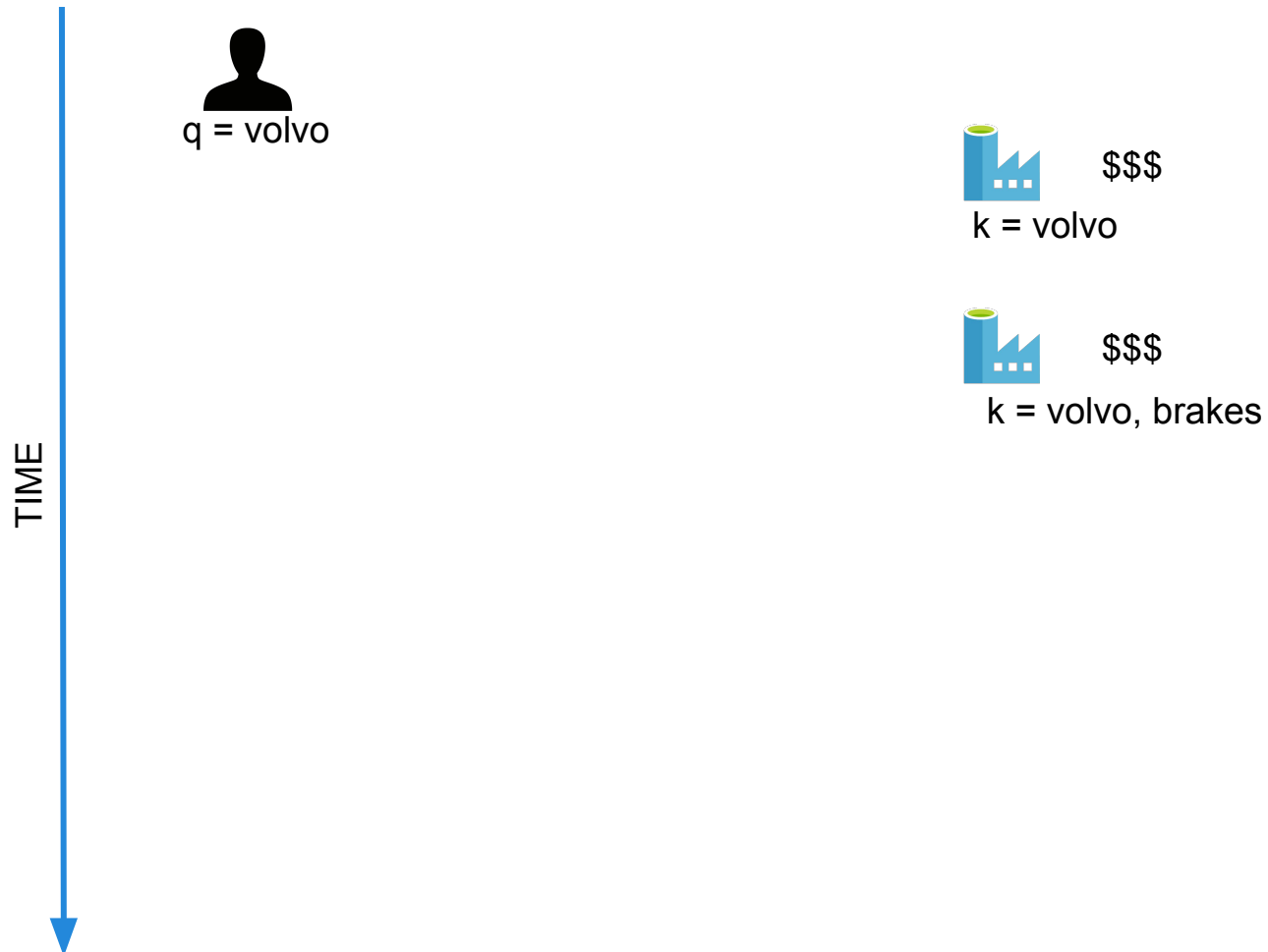


Balance algorithm

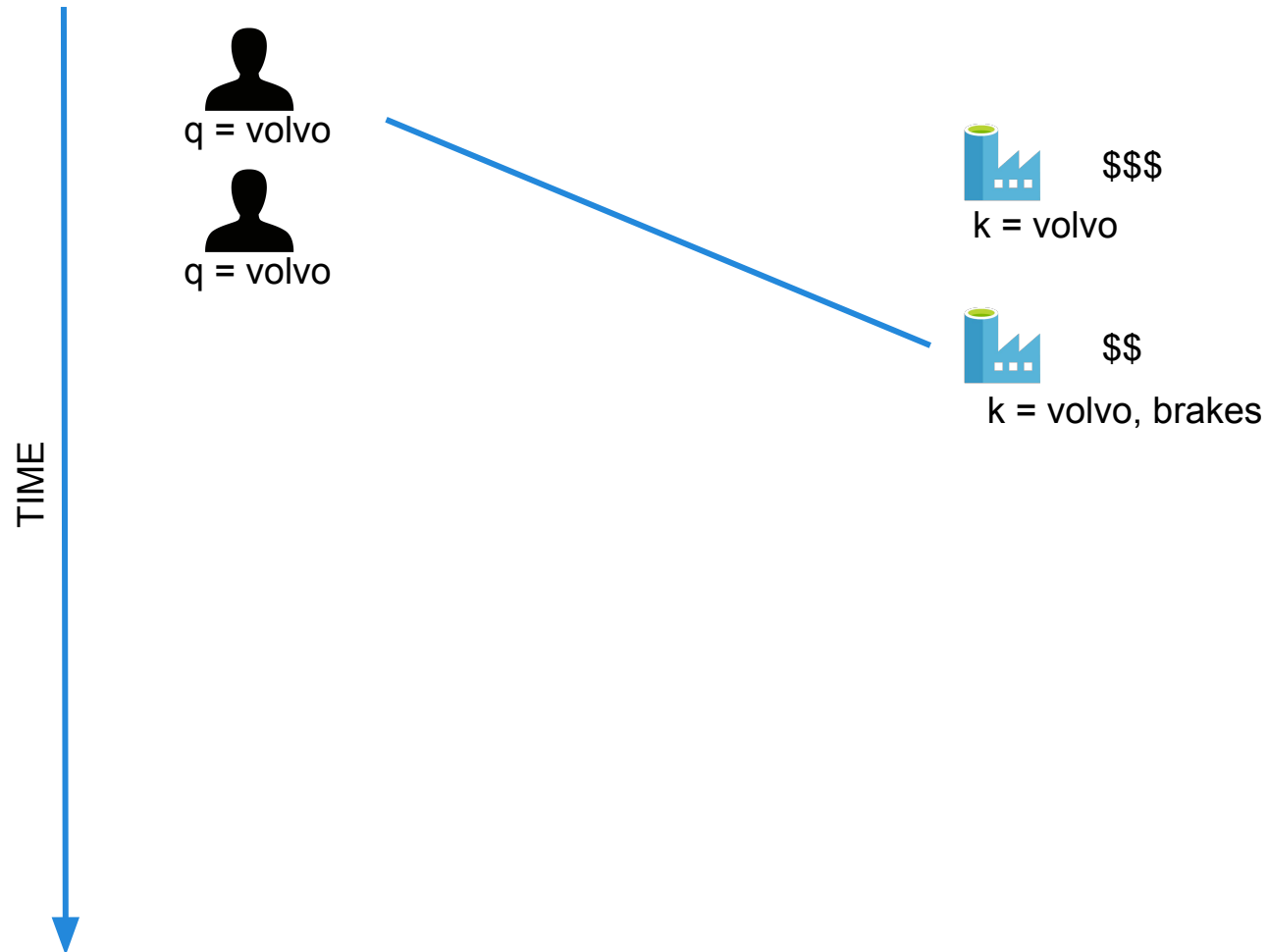
Balance algorithm

For each query, pick the advertiser with the largest unspent budget.

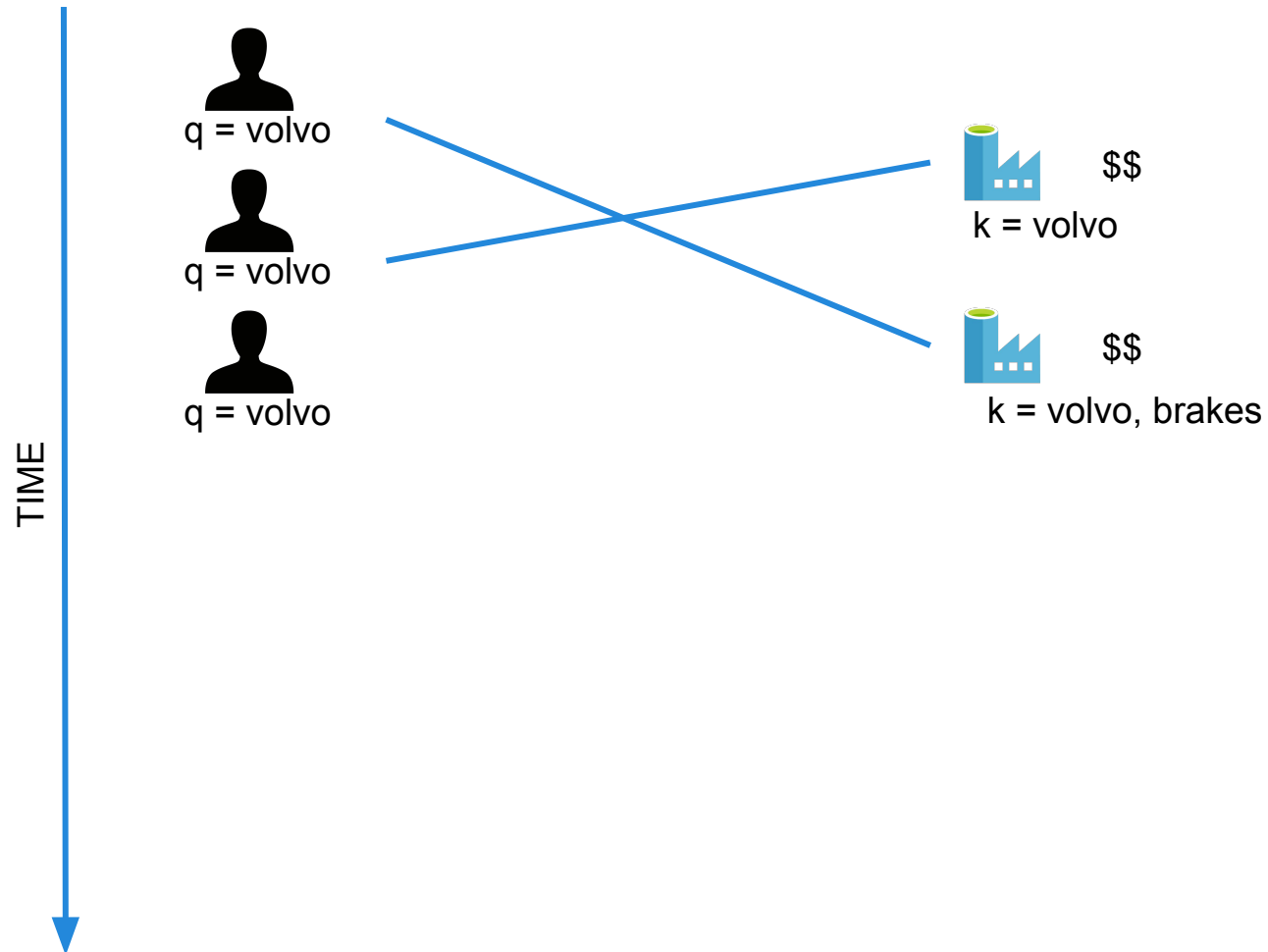
Adwords (simplified: $k=1$) model



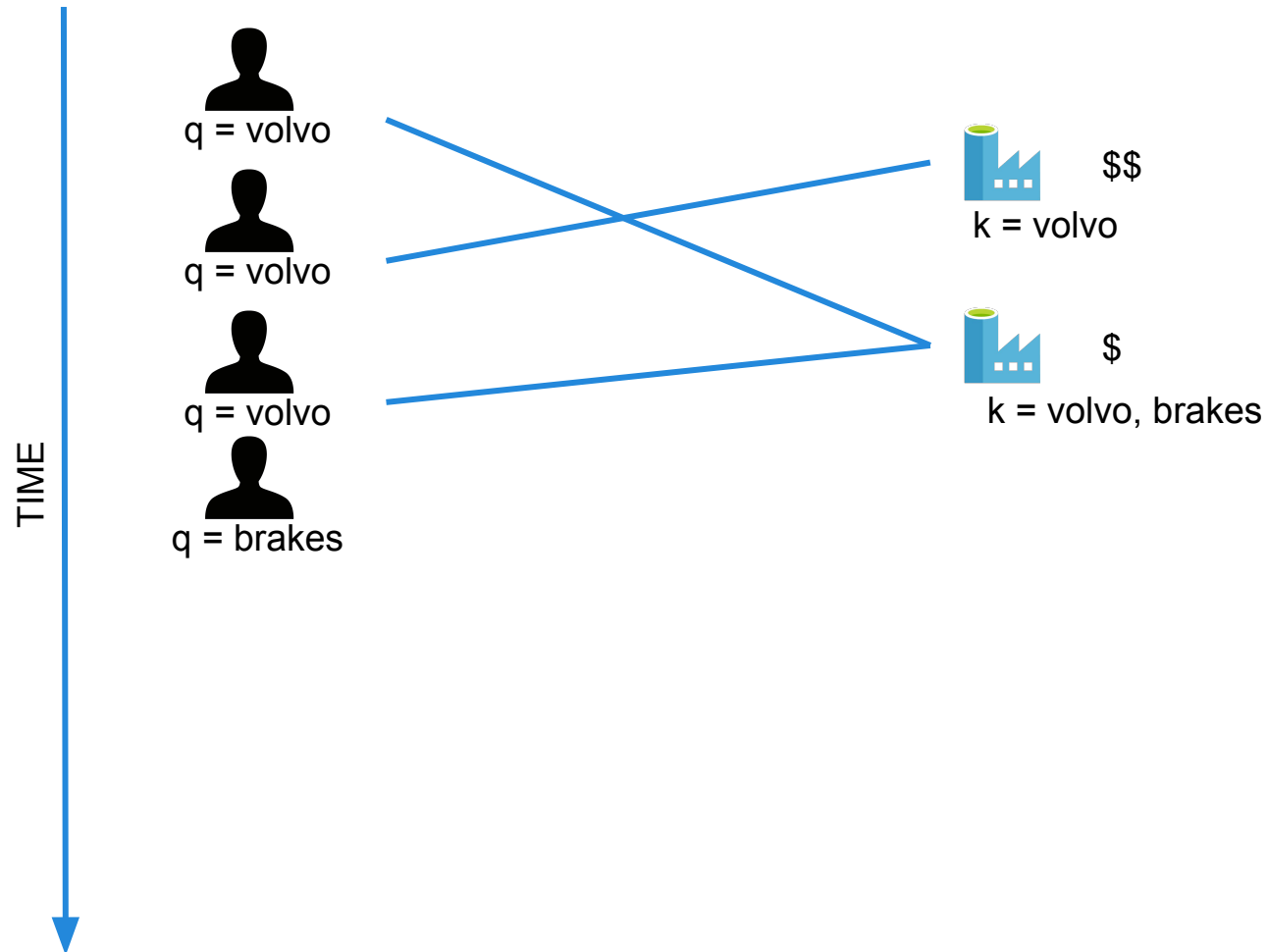
Adwords (simplified: $k=1$) model



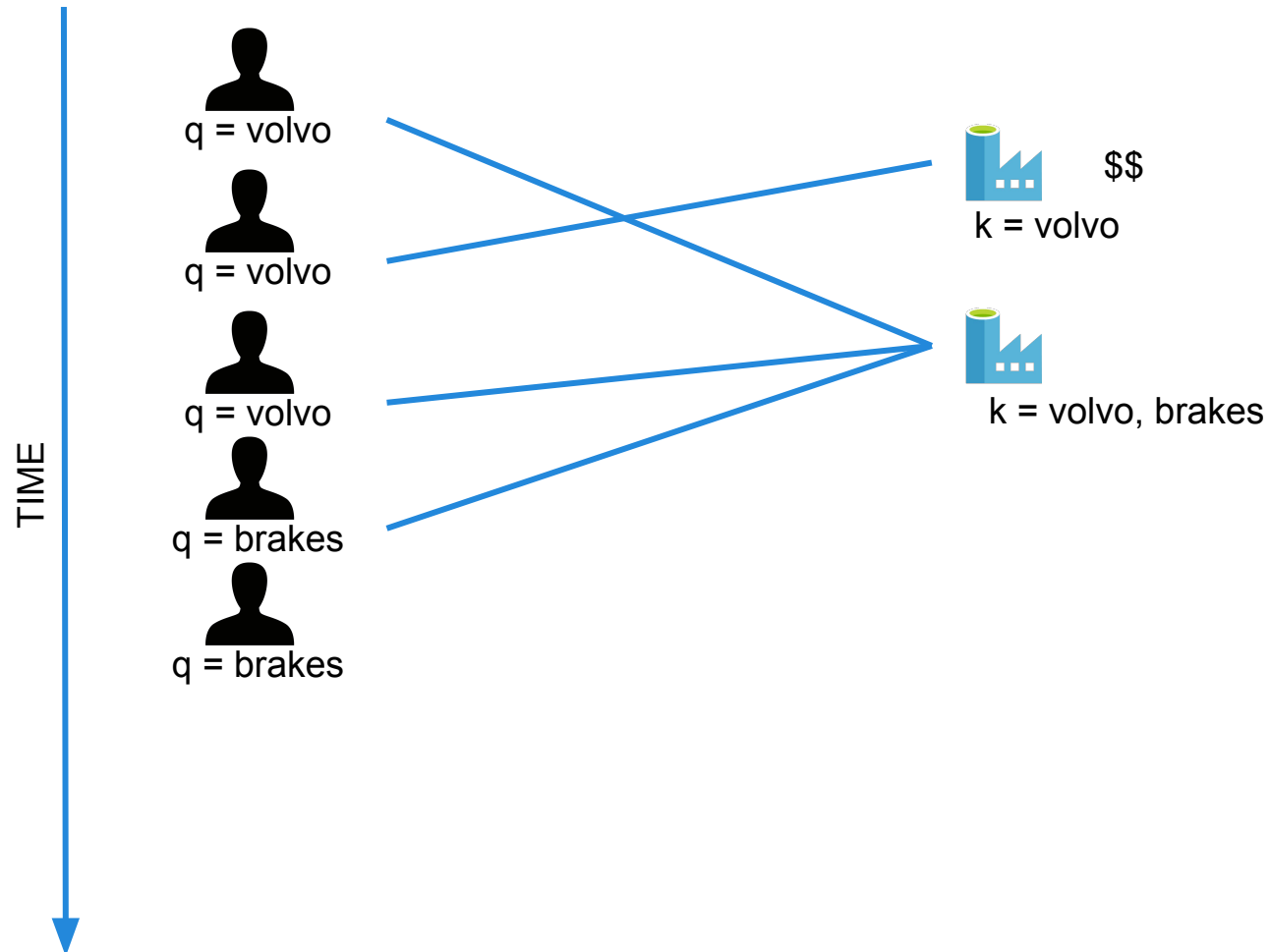
Adwords (simplified: $k=1$) model



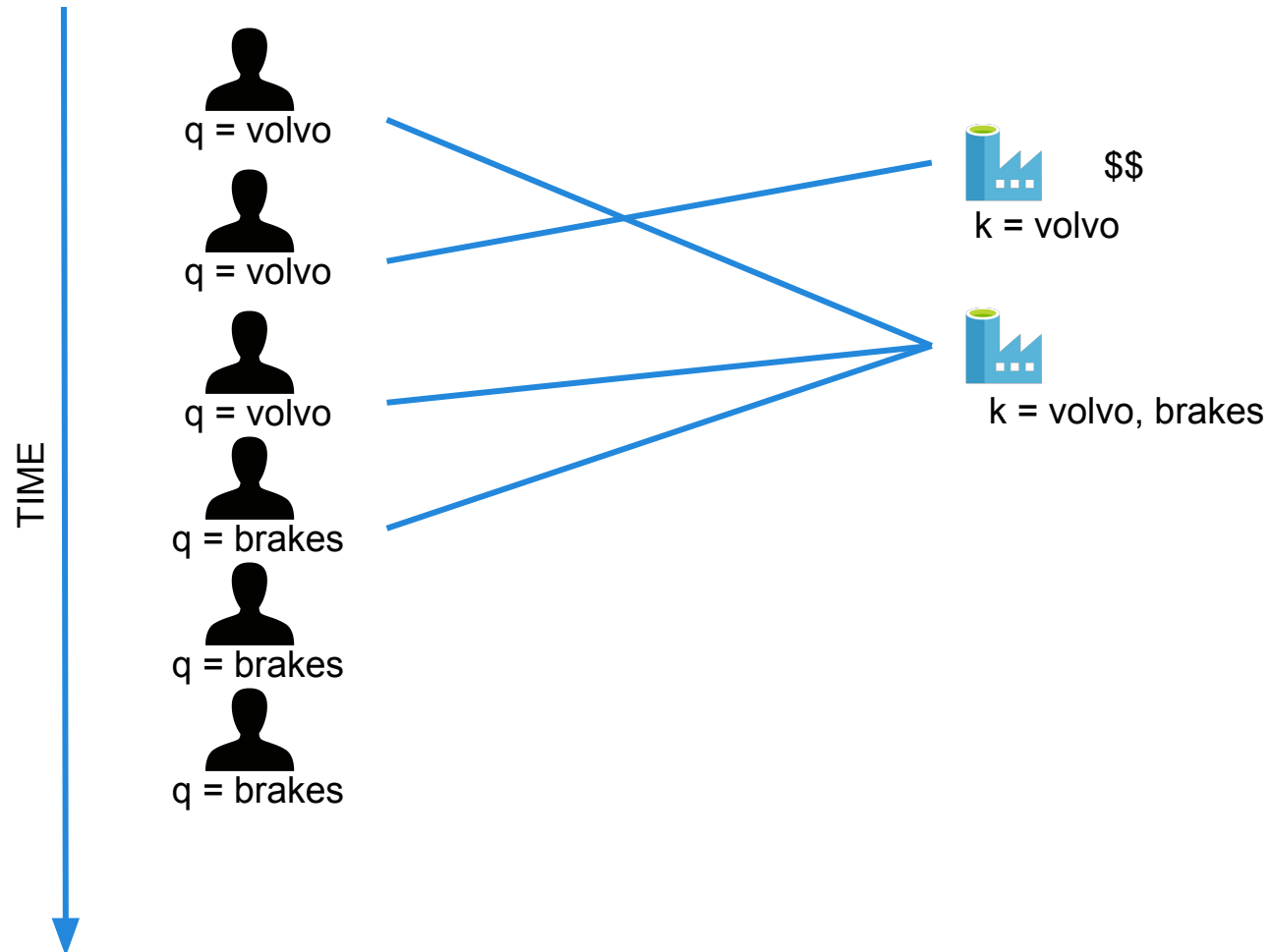
Adwords (simplified: $k=1$) model



Adwords (simplified: $k=1$) model

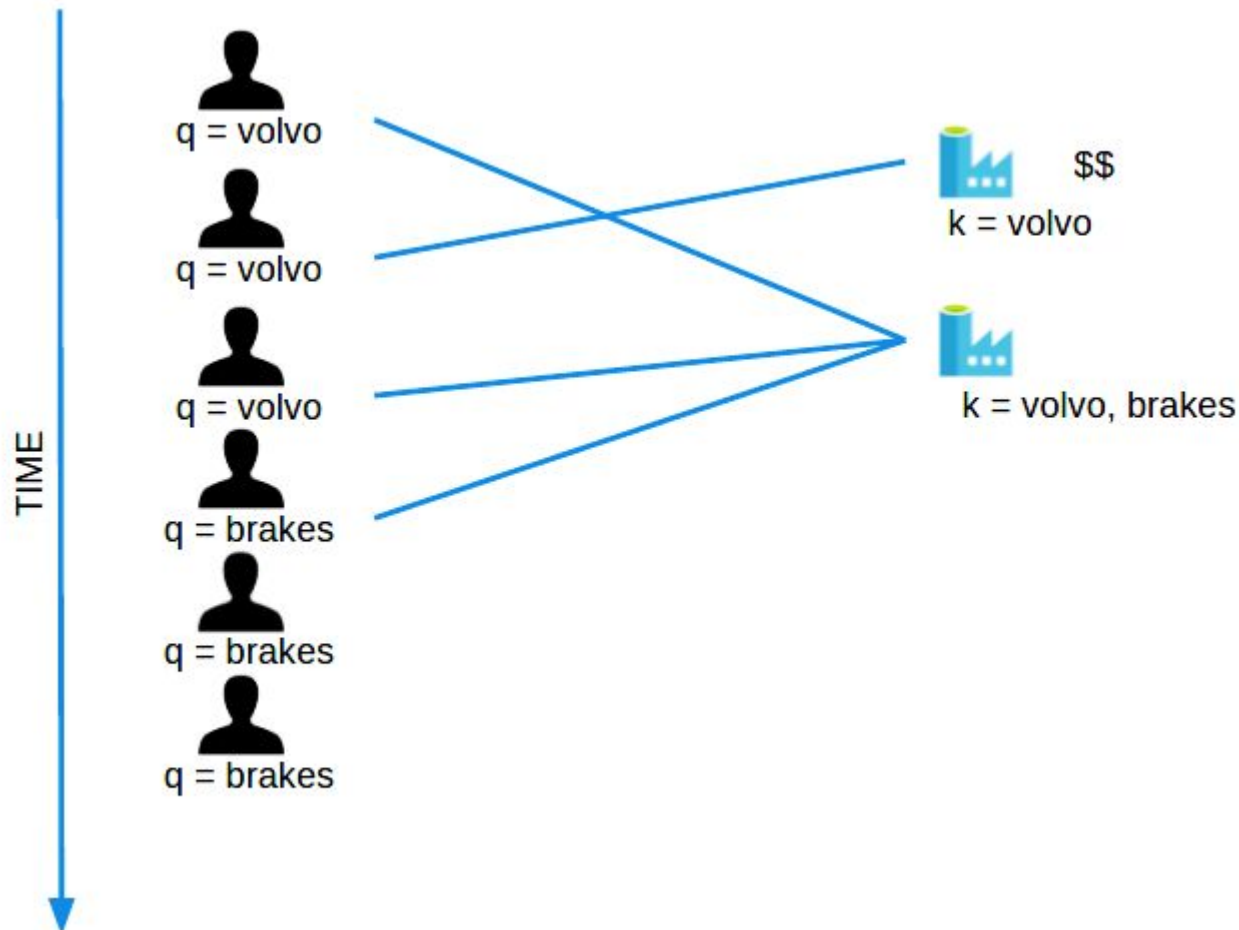


Adwords (simplified: $k=1$) model



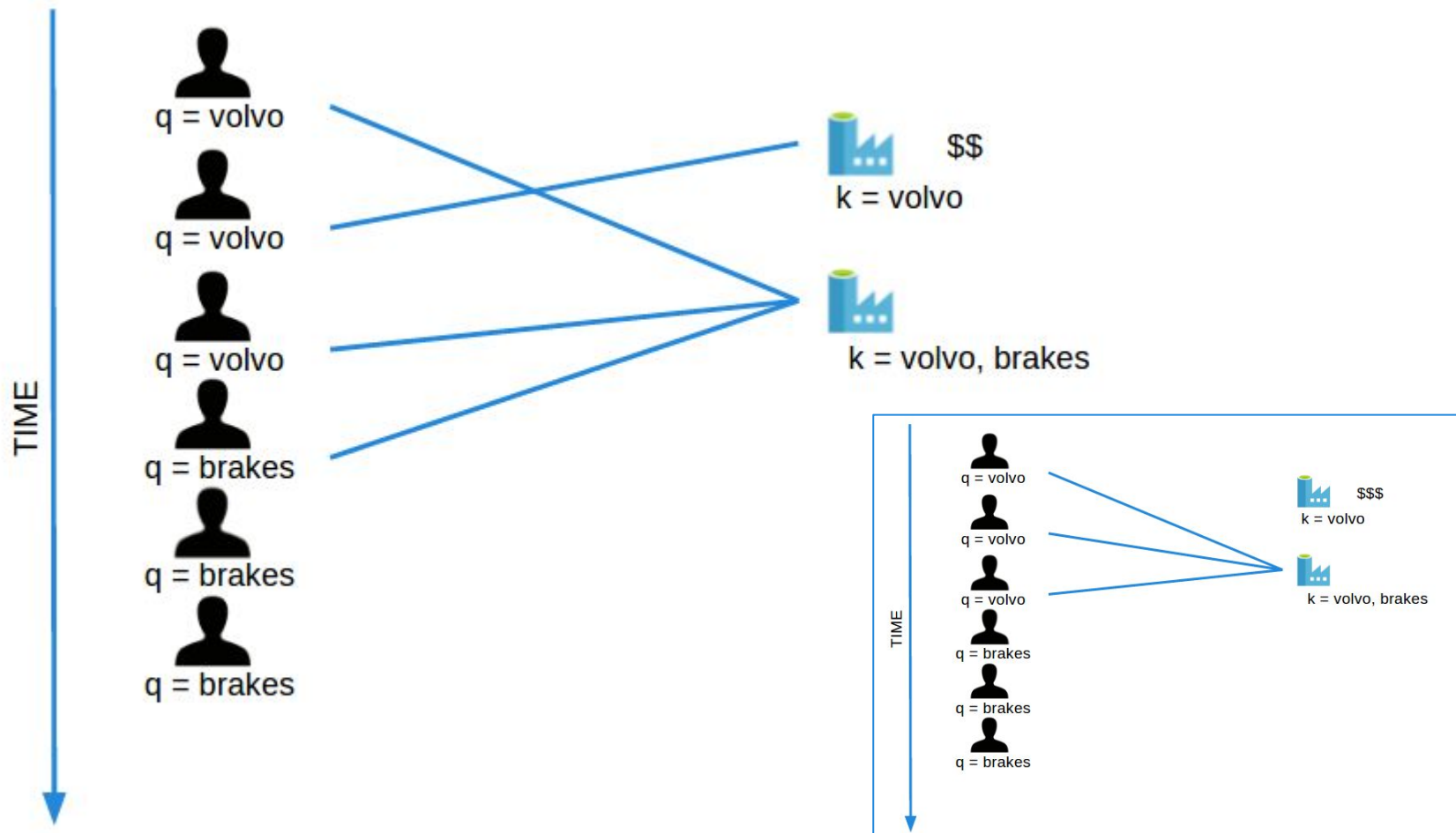
Competitiveness

For this data we matched $4/6 = 2/3$



Revenue

4\$ instead of optimal 6\$ but 1\$ more than for greedy



Balance competitiveness

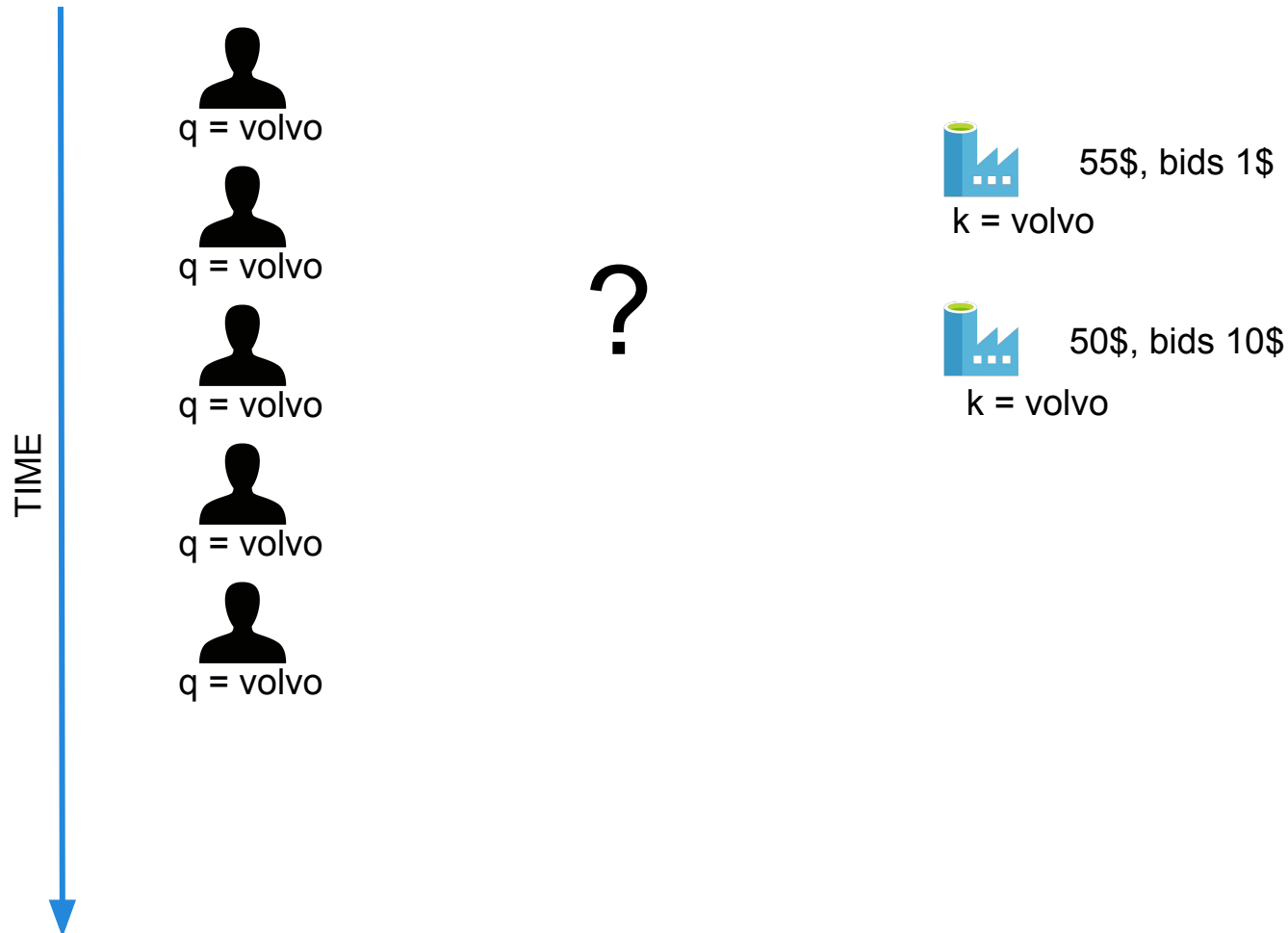
In the general case competitive ratio of BALANCE is $1 - 1/e = \text{approx. } 0.63$

Interestingly, no online algorithm has a better competitive ratio!

Balance competitiveness

OK, how about the more general situation?:
bids can be arbitrary

Balance Failure Example





Generalized Balance


- **Arbitrary bids:** consider query q , bidder i
 - Bid = x_i
 - Budget = b_i
 - Amount spent so far = m_i
 - Fraction of budget left over $f_i = 1 - m_i/b_i$
 - Define $\psi_i(q) = x_i(1 - e^{-f_i})$
- Allocate query q to bidder i with largest value of $\psi_i(q)$
- Same competitive ratio $(1 - 1/e)$


Generalized Balance (whiteboard)


TIME
↓


q = volvo


q = volvo


q = volvo


q = volvo


q = volvo



55\$, bids 1\$

k = volvo



50\$, bids 10\$

k = volvo

Generalized Balance (whiteboard)

1. $a=55$ $x=1$, $m=0$, $f_i=0.632121$
2. $a=50$ $x=10$, $m=0$, $f_i=6.321206$
selecting 2

1. $a=55$ $x=1$, $m=0$, $f_i=0.632121$
2. $a=50$ $x=10$, $m=10$, $f_i=5.506710$
selecting 2

1. $a=55$ $x=1$, $m=0$, $f_i=0.632121$
2. $a=50$ $x=10$, $m=20$, $f_i=4.511884$
selecting 2

1. $a=55$ $x=1$, $m=0$, $f_i=0.632121$
2. $a=50$ $x=10$, $m=30$, $f_i=3.296800$
selecting 2

1. $a=55$ $x=1$, $m=0$, $f_i=0.632121$
2. $a=50$ $x=10$, $m=40$, $f_i=1.812692$
selecting 2

1. $a=55$ $x=1$, $m=0$, $f_i=0.632121$
2. $a=50$ $x=10$, $m=50$, $f_i=0.000000$
selecting 1

1. $a=55$ $x=1$, $m=1$, $f_i=0.625371$
2. $a=50$ $x=10$, $m=50$, $f_i=0.000000$
selecting 1

Real life

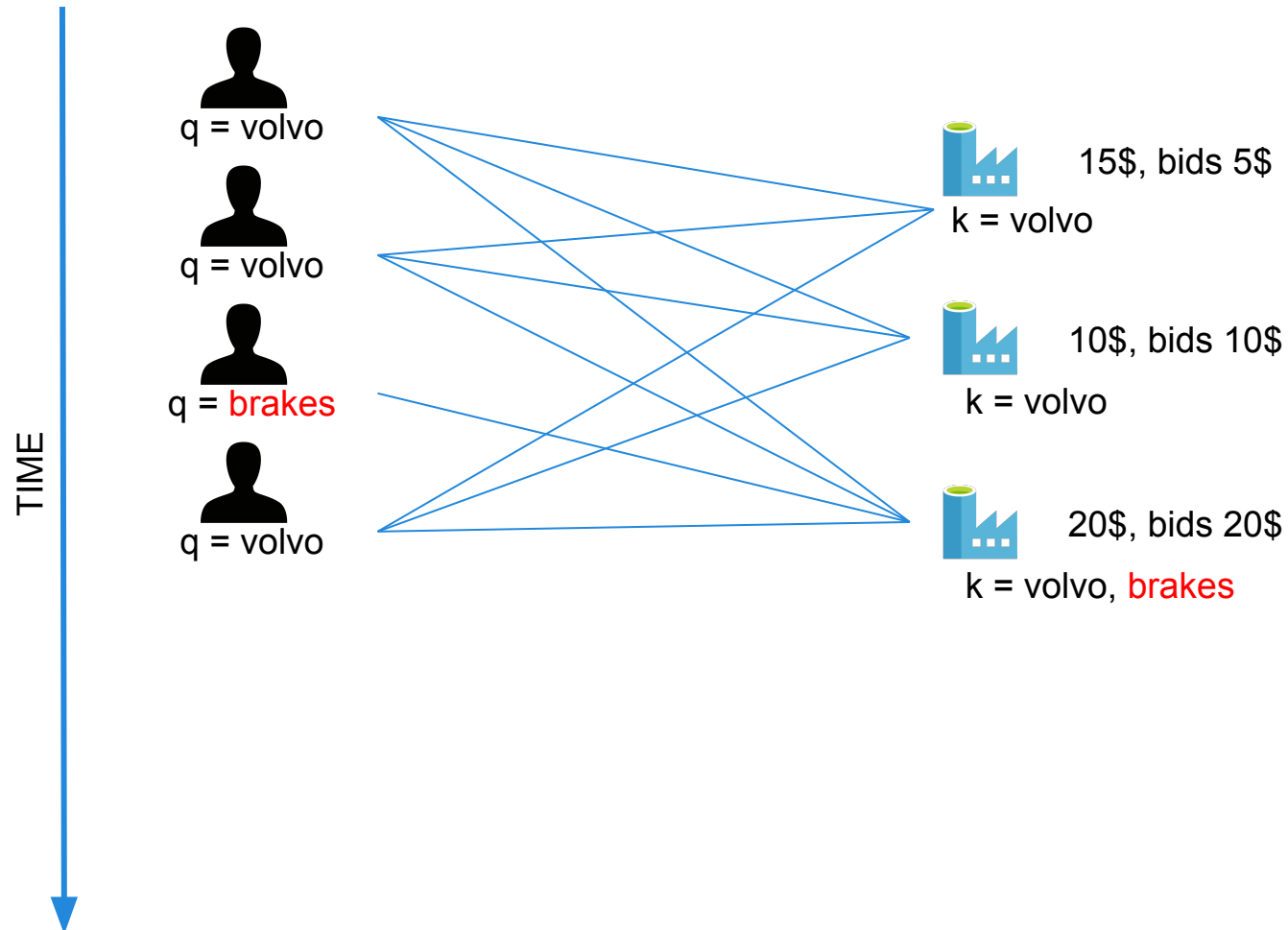
- Budgets differ
- Bids differ
- Bidders (companies) coming and leaving
- Matching is more complicated than keywords

Assignment

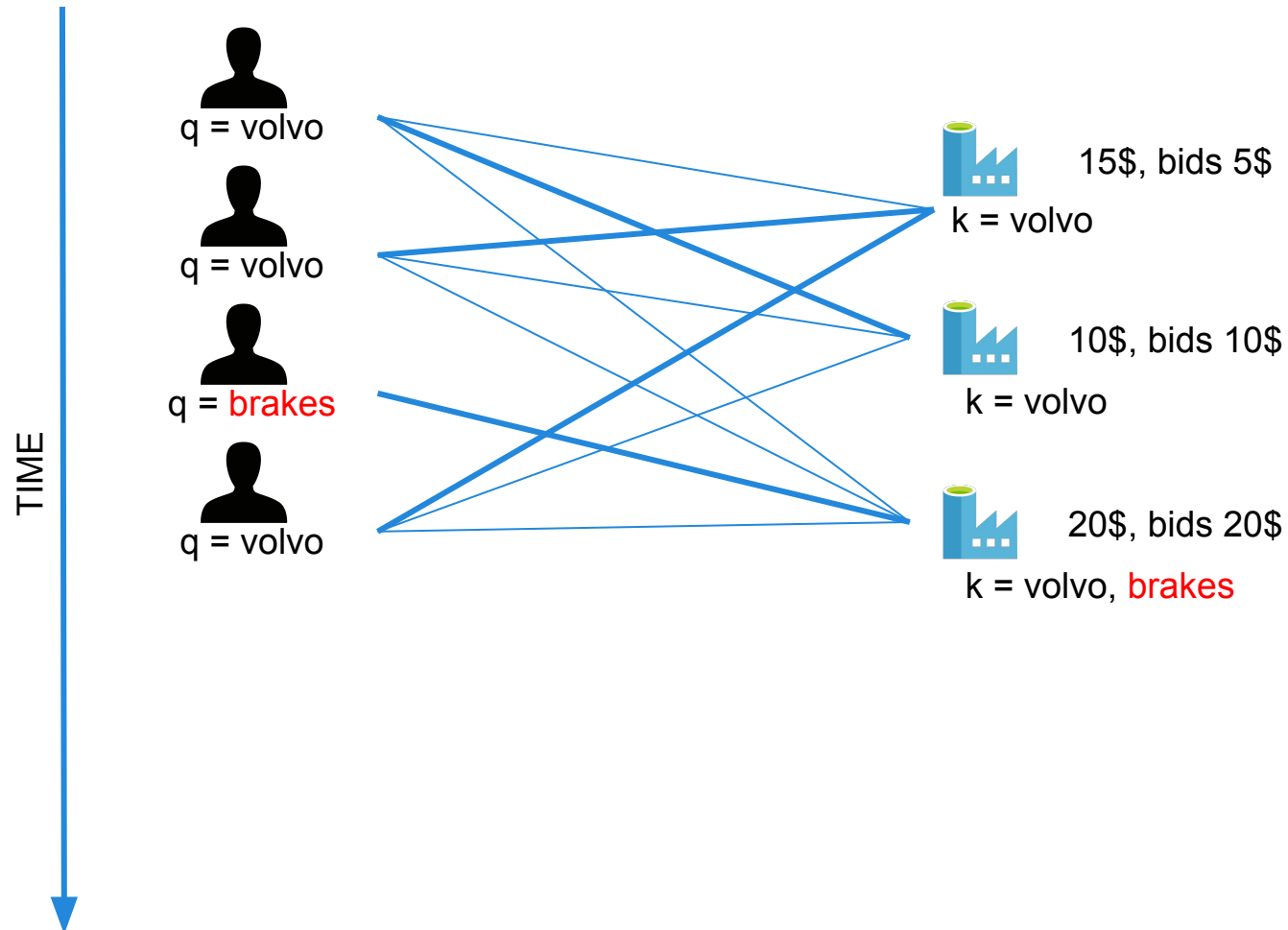
For the given below assignment problem:

- Find the optimal assignment (with max revenue)
- Find the Generalized Balance Algorithm solution.
- Compare matchings and revenues.

Problem



Solution: sample perfect matching

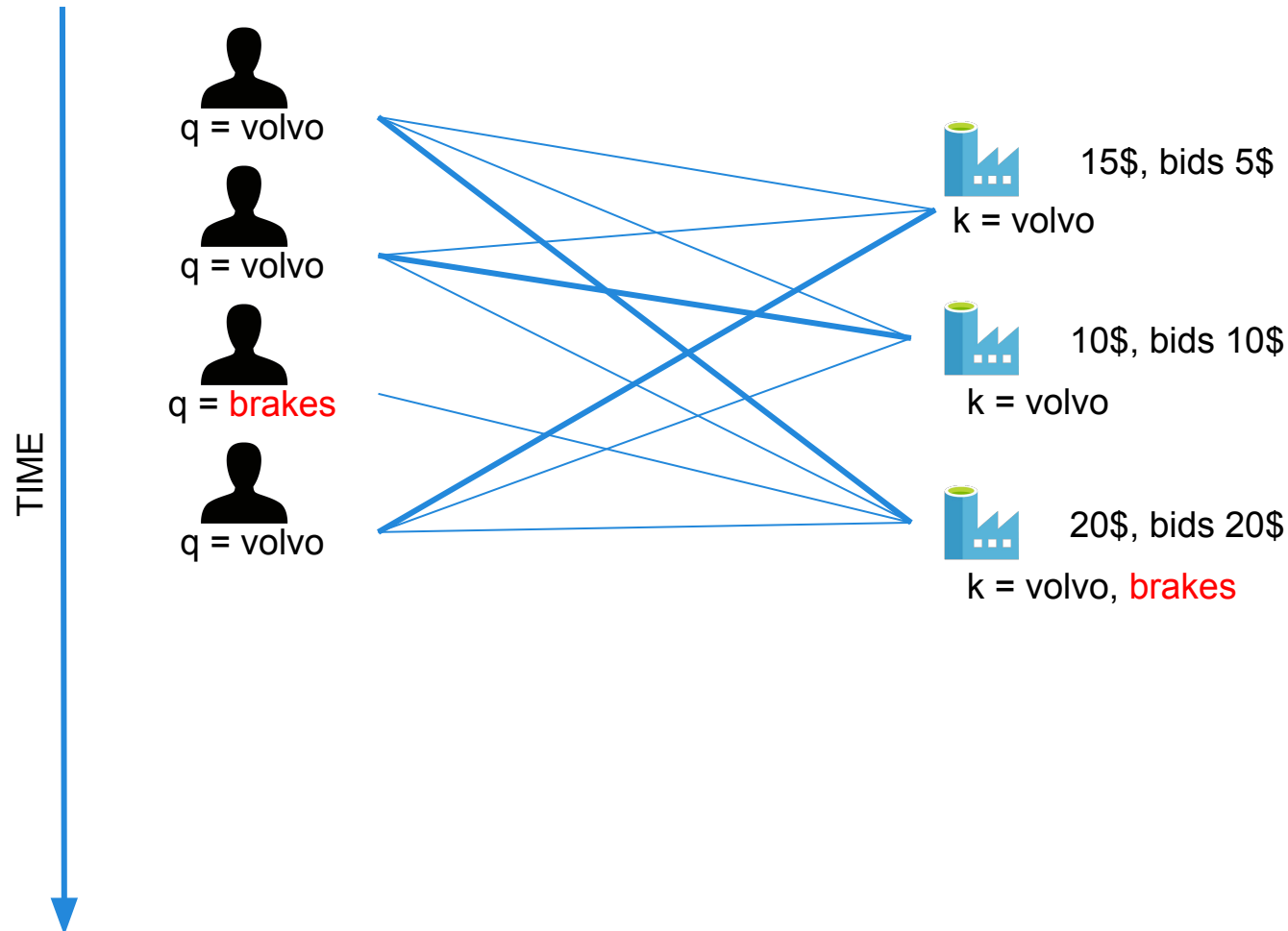


Solution: Generalized balance

i	m1	fi1	m2	fi2	m3	f3	Selected
1	0	3.16	0	6.32	0	12.64	3
2	0	3.16	0	6.32	20	0	2
3	-	-	-	-	20	0	NONE
4	0	3.16	10	0	20	0	1

User 3 has matching keywords only with the bidder no 3, but when he arrives the bidder has no more money to spend

Solution: Generalized balance



Solution

Revenues:

- Generalized balance: 35\$
- Perfect matching: 40\$

Matchings:

- Generalized balance: 3
- Perfect matching: 4