Fair combinatorial auction for trade intents

how to design mechanisms without a numeraire

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CoW DAO

Numeraire or no numeraire?

Numeraire: an asset that everybody values

- **Offchain**: there is usually a numeraire
  - Example: stocks are traded against the national currency
- Possible exception: forex markets?
  - 100 different currencies, with the top 5 pairs accounting for about 65% of total volume (all involve the US Dollar).

- **Onchain**: usually no numeraire
  - Anonymous participants, could be anywhere in the world
  - May want to swap any asset for any other asset
  - There are thousands of different assets

The absence of a numeraire makes harder to share the gains from collaboration

Example: **trade intent auctions**

- There are additional efficiencies if orders are executed together
- But these efficiencies may materialize in an asset that one of the users does not want
- Do you want to execute the two orders together? And if you do, how do you share the benefit?

New research: *Combinatorial Auctions without a Numeraire: The Case of Blockchain Trade-Intent Auctions*

1. A theoretical model of trade intent auction
2. Use it to compare the two most-common auction formats for trade intent: Batch auction vs separate individual auctions
3. Propose a new auction format: the fair combinatorial auction
    - A merge between batch auction and individual trade intent auction
    - If properly designed, the fair combinatorial auction can provide strong farness guarantees

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3. Propose a new auction format: the fair combinatorial auction
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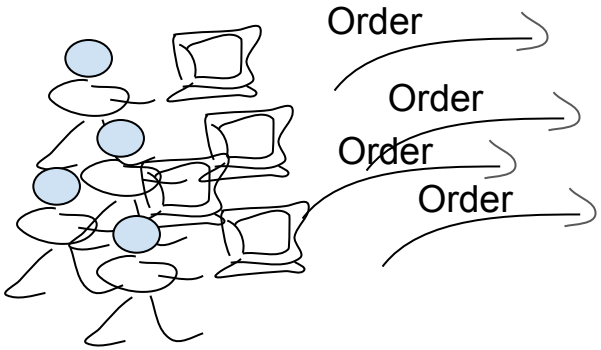
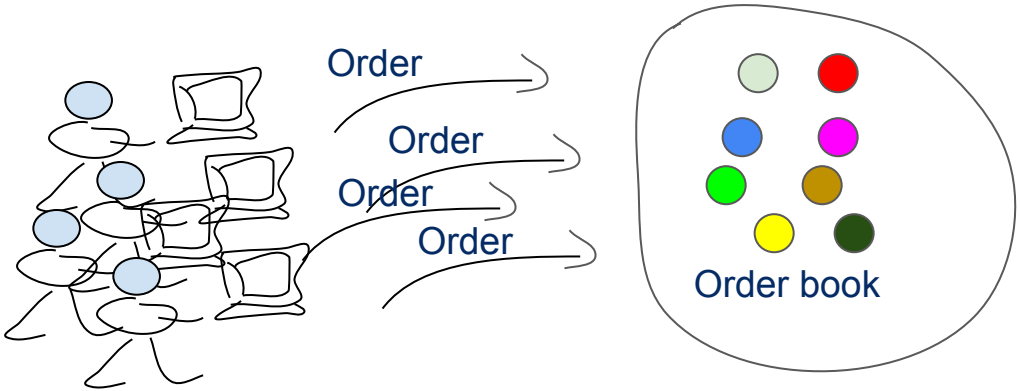
    - ~~If properly designed, the~~ *a* fair combinatorial auction ~~can~~ that provides strong farness guarantees

Batch auctions (vs separate individual auctions)

CoW Protocol’s batch auction



CoW Protocol’s batch auction



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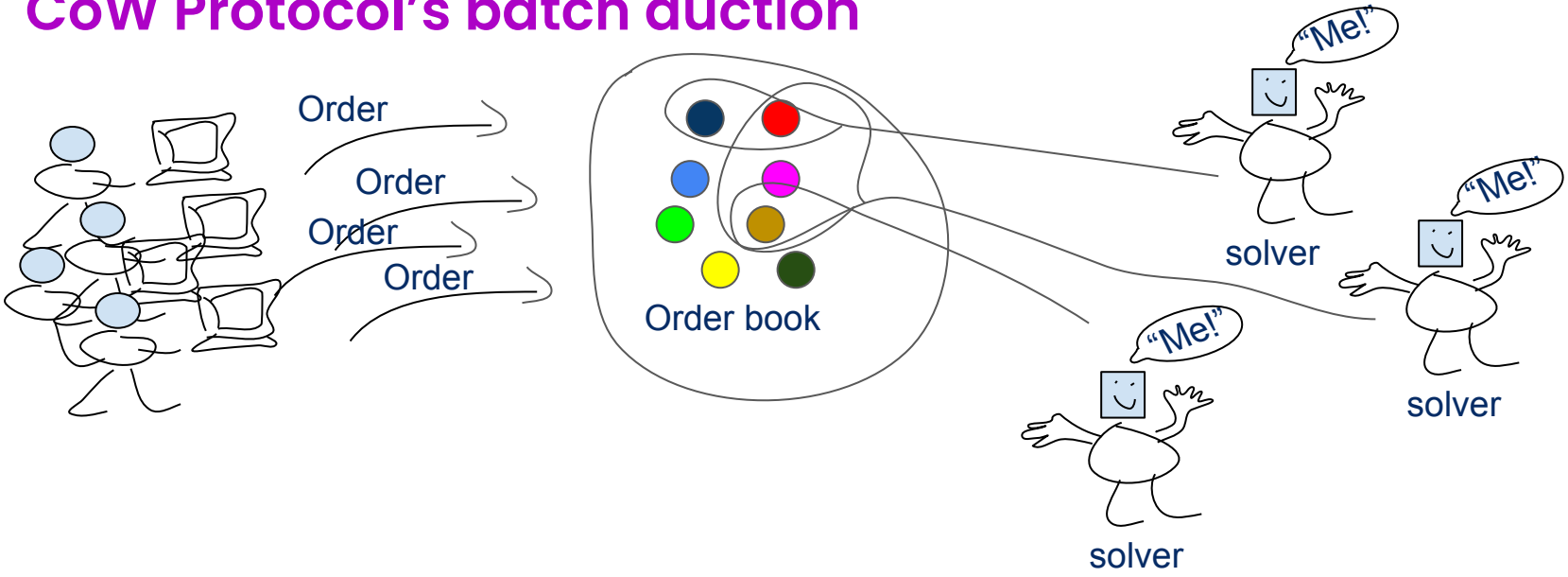

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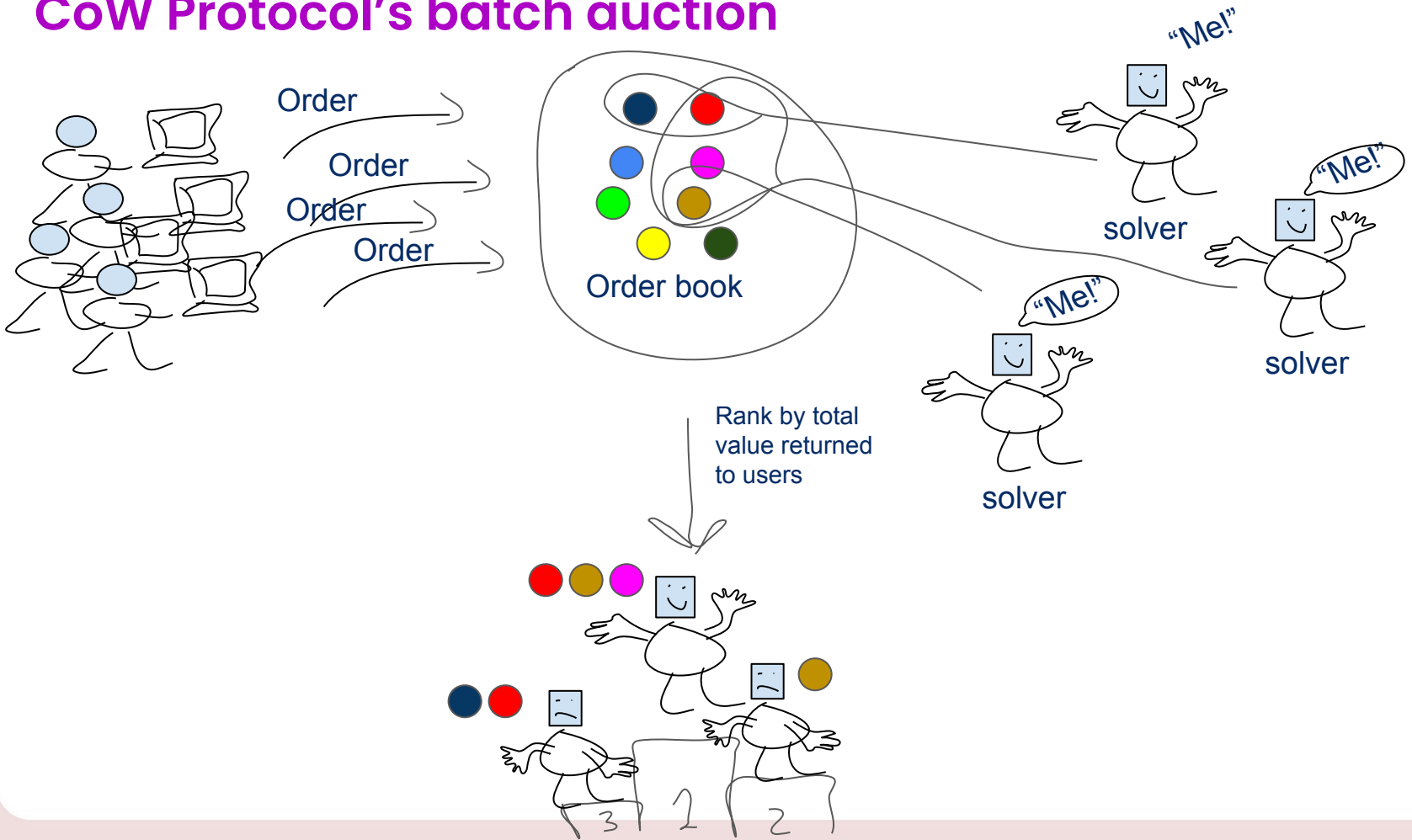


CoW Protocol's batch auction (vs other protocols)

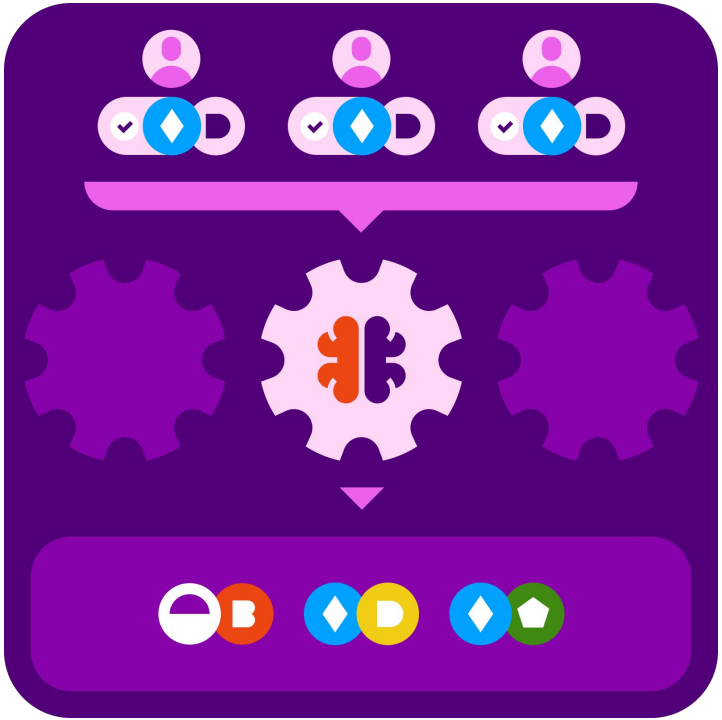
Collects trade intents

Runs an auction among "solvers":

- Each solver proposes a price for each trade on the batch
- The best solution wins
- (note: you need an oracle price)

Other protocols: 1inch fusion and Uniswap X

- a separate (Dutch) auction for each trade



Batch auctions vs individual-trades auctions

Batch auctions: better at exploiting **complementarities between different trades**

Batch auctions: better at generating **competition between solvers**

Individual trades auctions: better at exploiting **solvers' specialization**

Batch auctions can be unfair, i.e., worse for some traders than an individual-trade auction

- Current fix: EBBO

The billion dollars question

Is there a mechanism that can result in **batching or specialization** (depending on what is most efficient), **generates competition** between solvers, and is **fair**?

Fair Combinatorial Auction

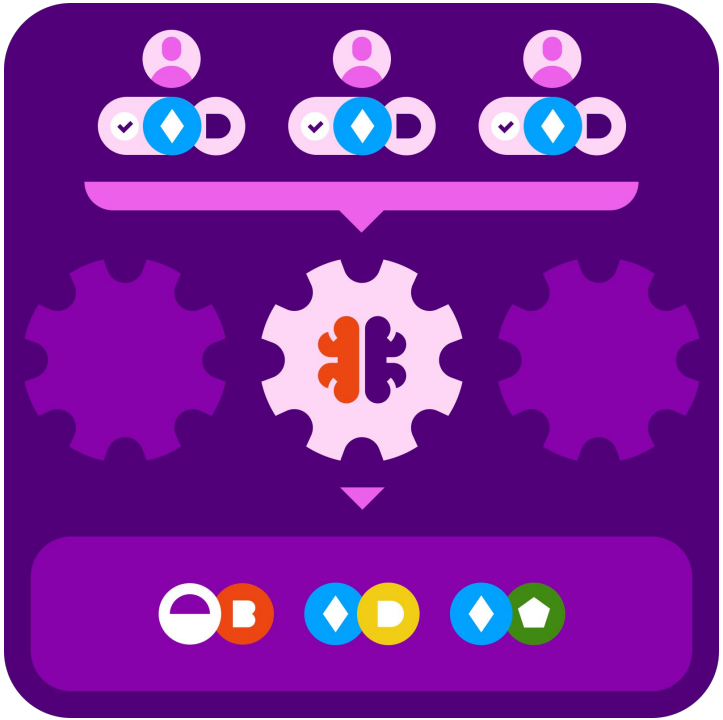
Fair Combinatorial Auction

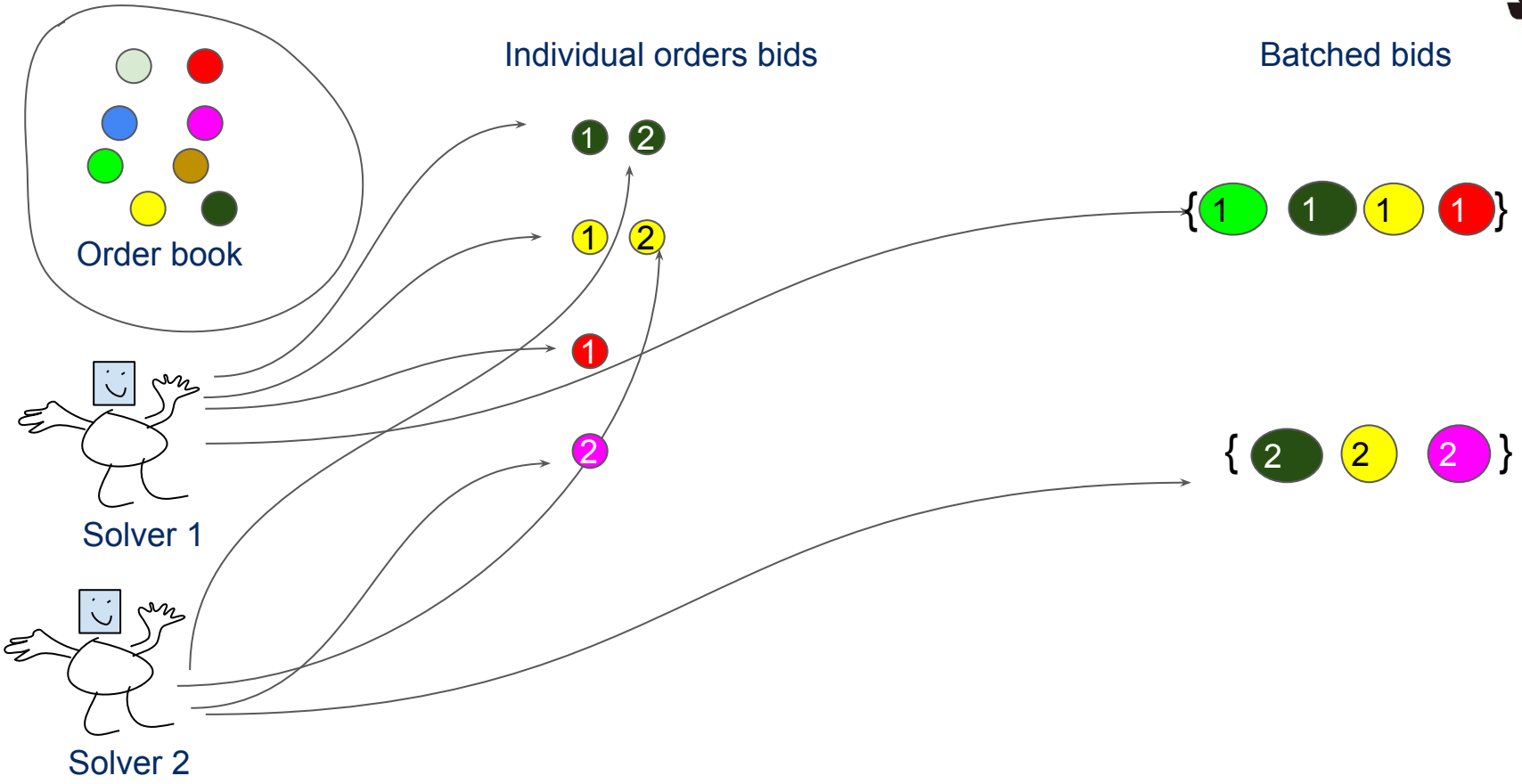
Multiple bids per solver: each solver can bid both on individual trades and on batches of trades

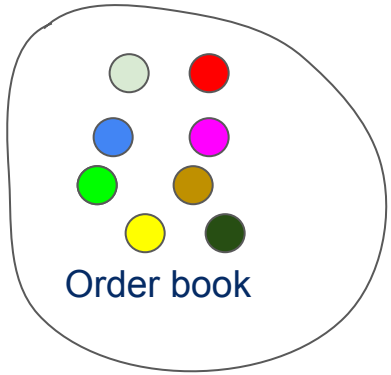
Filtering of batched bids:

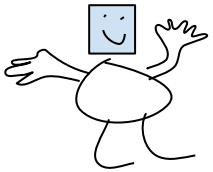
- Consider only the individual trade bids
- Calculate the outcome of several simultaneous ***first price**** auctions with those bids -> reference outcome
- Filter out a batched bid if it is worse than the reference outcome for at least one trader

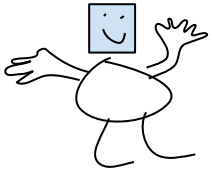
Choose the winner(s) among the surviving batched bids & individual trade bids




Individual orders bids
Batched bids
Order book
Solver 1
Solver 2
1
2
1
2
1
2
{ 1 1 1 1 }
{ 2 2 2 }




Solver 1


Solver 2

Individual orders bids

max(1 ,2)= * (reference outcome)

max(1 ,2)= * (reference outcome)

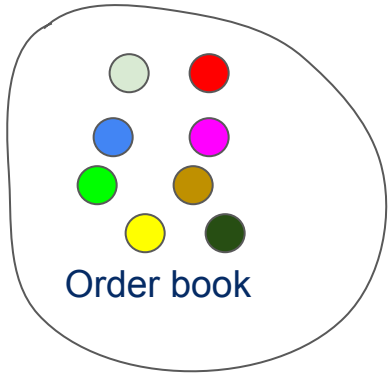
max(1 ,)= * (reference outcome)

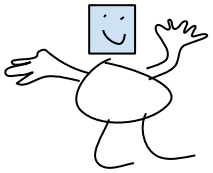
max(2 ,)= * (reference outcome)

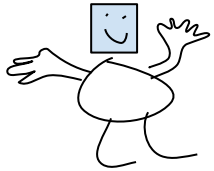
Batched bids

{1 1 1 1}

{ 2 2 2 }







Individual orders bids

max(1 ,2)= *

max(1 ,2)= *

max(1 ,)= *

max(2 ,)= *

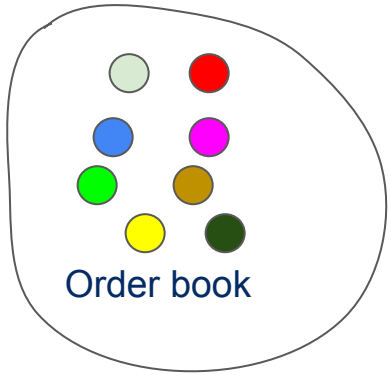
Batched bids

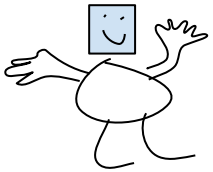
{1 1 1 1}

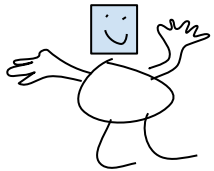
Filter out if 1 < * or 1 < * or 1 < *

{ 2 2 2 }

Filter out if 2 < * or 2 < * or 2 < *







Individual orders bids

max(1 ,2)= *

max(1 ,2)= *

max(1 ,)= *

max(2 ,)= *

Batched bids

{1 1 1 1}

Filter out if 1 < * or 1 < * or 1 < *

{ 2 2 2 }

Filter out if 2 < * or 2 < * or 2 < *

Final winners: {1 1 1 1} 2

Fair combinatorial auction: strategic considerations

- **higher individual trade bids** (than in a standard first price auction) to filter out the opponents' batched bids

- **lower batched bids** (than in a batched auction) if they think that their opponents' batched bid may be filtered out

Fair combinatorial auction: In equilibrium

- **Fairness guarantees:** Solvers return **strictly more** to the traders than in simultaneous first price auctions
- Batching or specialization: depending on their relative benefits
- If the equilibrium is batching, the winning solver may return **less** to the traders than in the batch auction

Fairness guarantees, sometimes at the expense of the total value returns to users

Conclusions

- *Trade intent auction are the future*
- *There are efficiencies from batching*
- *Fairness is a concern*
- *Solution: the fair combinatorial auction*

Paper:

Thank you!

Stay in touch with us!
Moooo

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