

# On the Coordination of Value-Maximizing Bidders

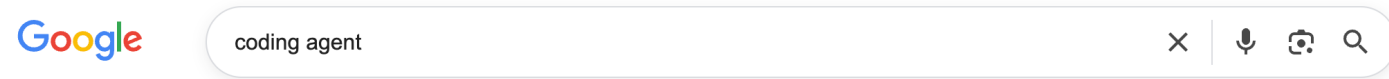
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# Online Ad Campaign



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More than 80% of Google advertisers are using automated bidding.

Source: Google Internal Data, Global, 2021-03-16 to 2021-04-12.

## Auto-bidding:

- The advertiser submits the goal and constraints
- The delegated bidding agent runs an algorithm  $A$  for the advertiser
- How to bid over repeated auctions?

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Independent

existing work

**Coordination**

?

# Model

- Repeated second-price auction,  $T$  rounds
- Goal: maximize realized value
- Return-on-Spend (RoS) constraint
  - RoS target ratio is normalized to 1
- $N$  bidders  $v_{i,t} \sim F$  against 1 outside bid  $d_t^0 \sim D$

$$\begin{aligned} \max_{\{b_{i,t}\}_{t=1}^T} & \sum_{t=1}^T v_{i,t} \cdot x_{i,t} && \text{(bidder } i\text{'s value)} \\ \text{s.t.} & \sum_{t=1}^T u_{i,t} = \sum_{t=1}^T v_{i,t} \cdot x_{i,t} - \sum_{t=1}^T p_{i,t} \geq 0 && \text{(RoS constraint)} \end{aligned}$$

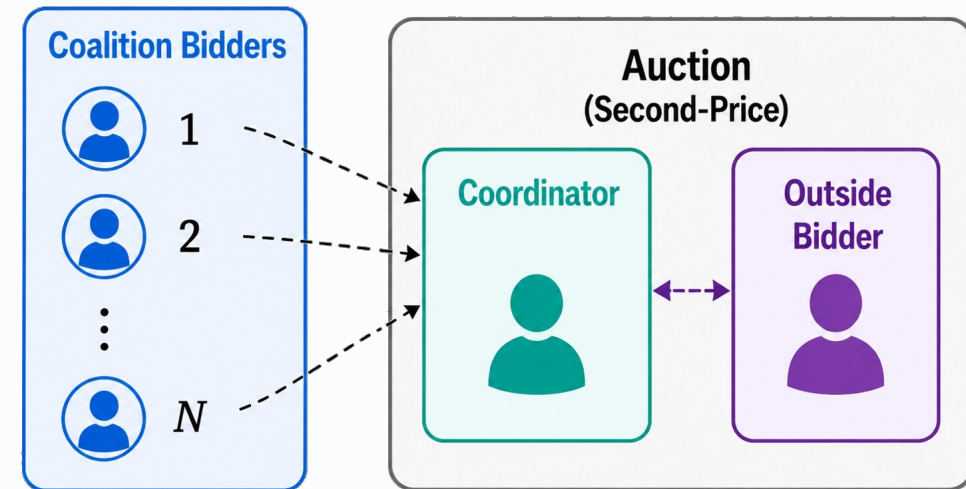
# Auto-bidder Coordination

- In practice, multiple bidders are often managed by the same platform or advertiser.
- Compare: whether  $N$  bidders form a coalition or not.

## Independent

- Each bidder runs a mirror-descent algo [1]
  1. Overbid  $b_{i,t} = (1 + 1/\lambda_{i,t})v_{i,t}$
  2. Observe utility  $g_{i,t} = v_{i,t}x_{i,t} - p_{i,t}$
  3. Update:  $\lambda_{i,t+1} = \lambda_{i,t}e^{-\alpha g_{i,t}}$
- Can be generalized to a class of mirror-descent algo

## Coordination



# Main Results: Simple Coordination Helps

Rule: in each round, only the coalition bidder with **highest value** bids.

## 1. Better RoS Compliance:

Exact condition\* for every bidder's expected utility to improve

## 2. Higher Coalition Value:

Coordination improves total value asymptotically for any mirror-descent algo

## 3. Value Asymptotic optimality:

Under the same condition\*, asymptotically no better coordination mechanism

\* Condition: The top two coalition values are competitive against the outside bid:  $\Delta = E \left[ (v_{(N-1)} - d^o)^+ - (d^o - v_{(N)})^+ \right] \geq 0$

# Experiments

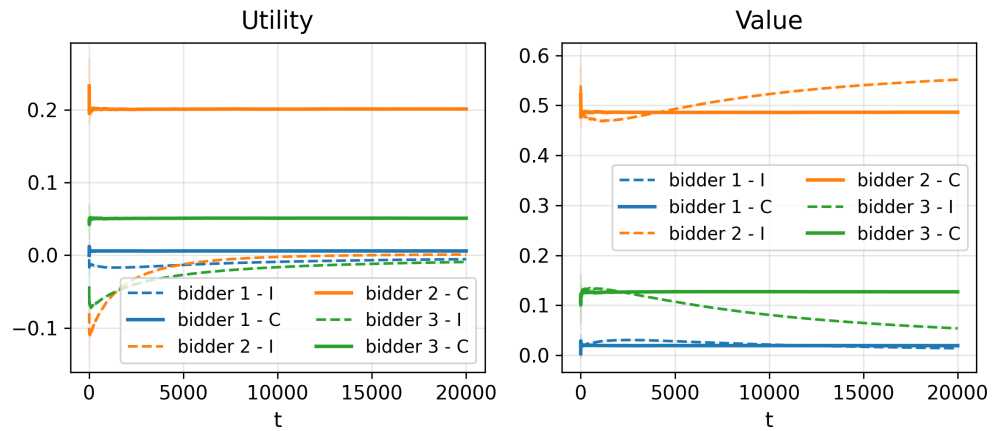


Fig 1. Non-i.i.d. Synthetic Data

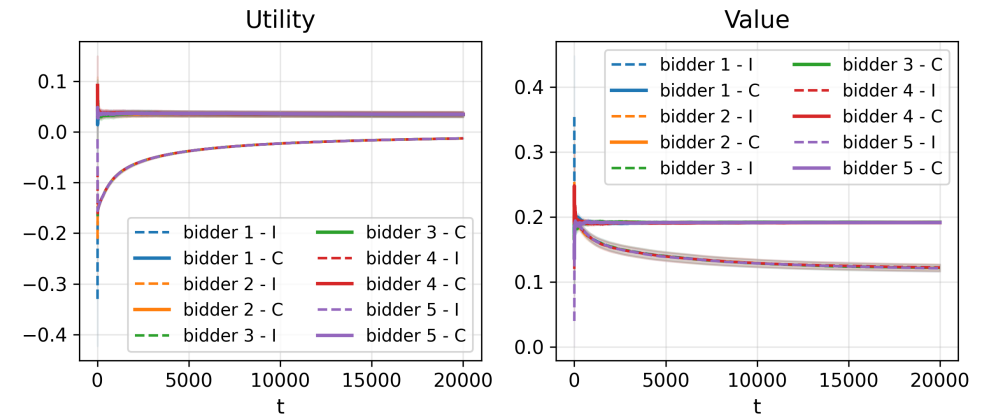


Fig 2. iPinYou Dataset

Coordination improves coalition-level utility/value across synthetic and real-data experiments.

**Questions?**

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