Intro to Ad-Click Simulator

Castle Lab @ Princeton U.

Apr 11, 2018

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1. Sponsored Search Auction
2. Simulator Description
3. Simulator Code Structure
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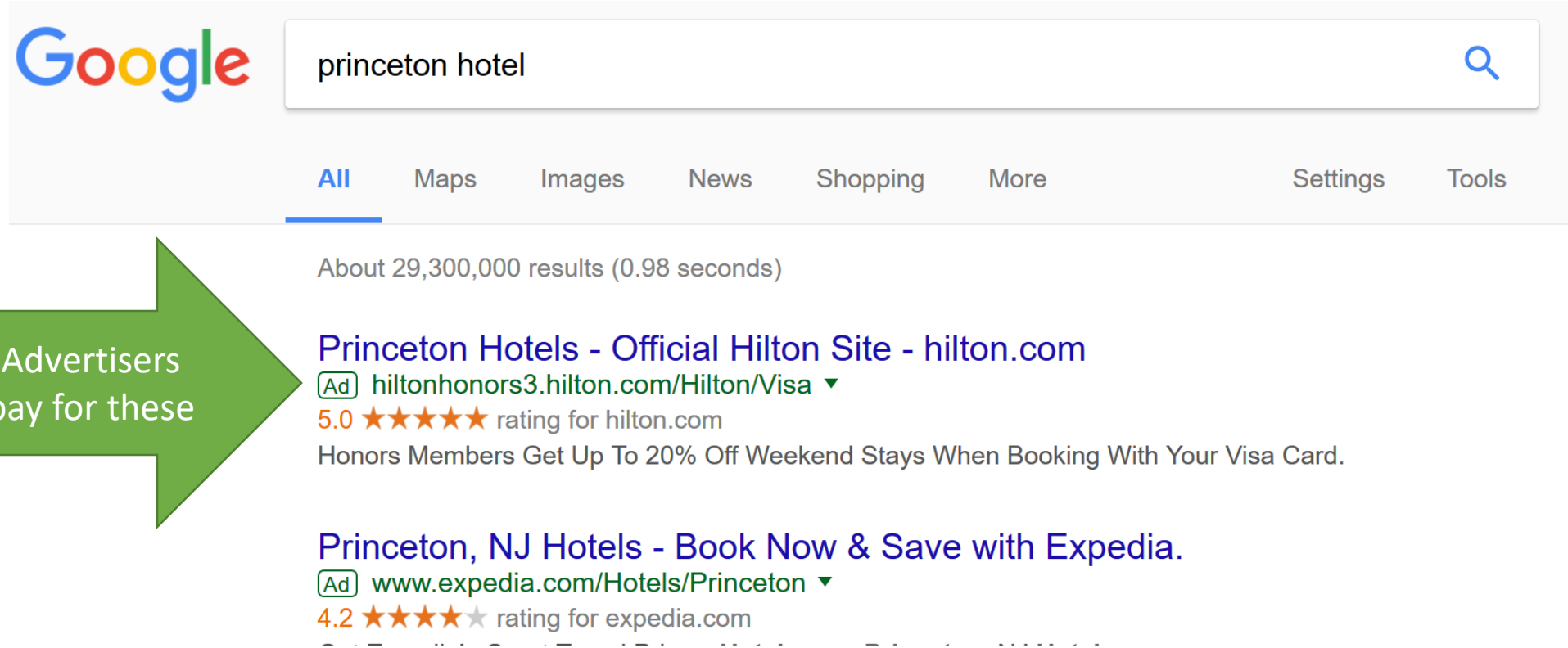
Sponsored Search Auction

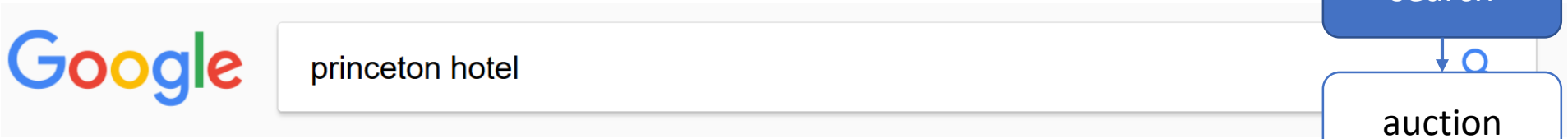
Sponsored Search Auction (SSA)

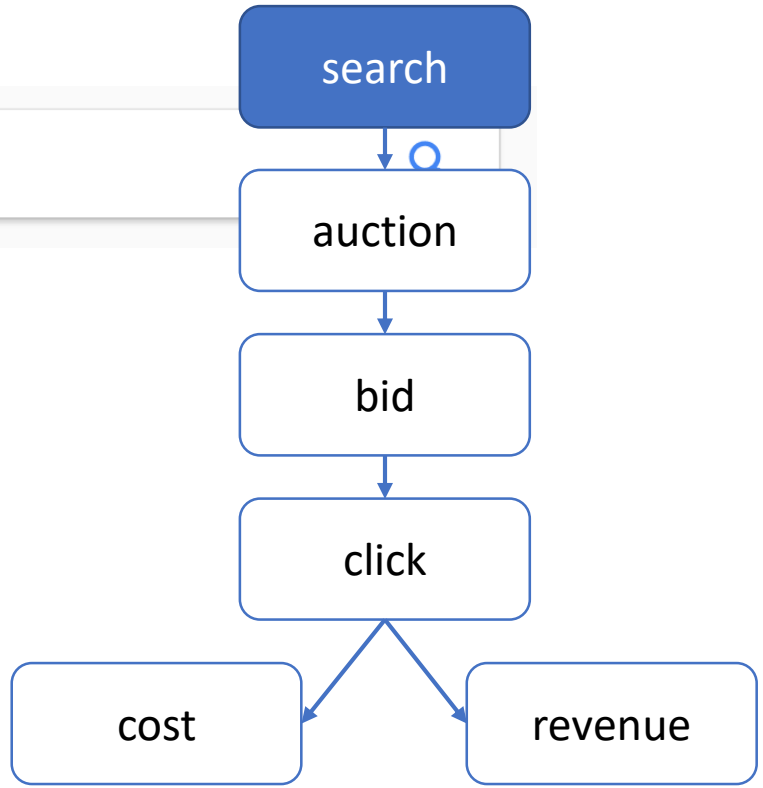
- Sponsored search auction result



How to Bid in SSA

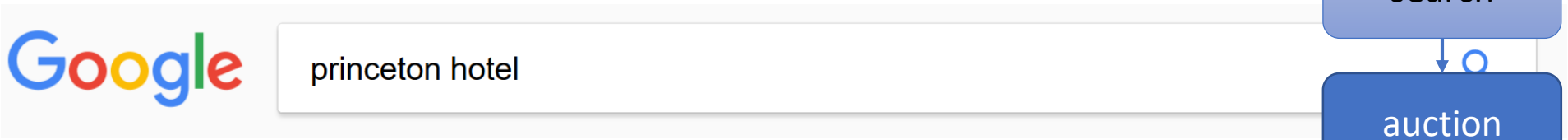
- When someone sends in a search query



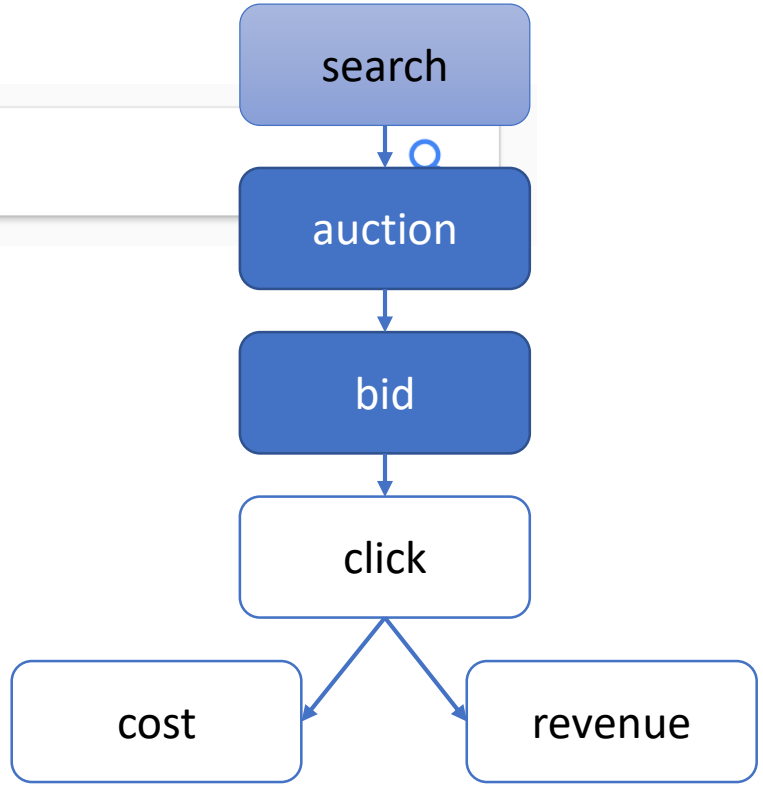


How to Bid in SSA

- Auction happens behind the curtain

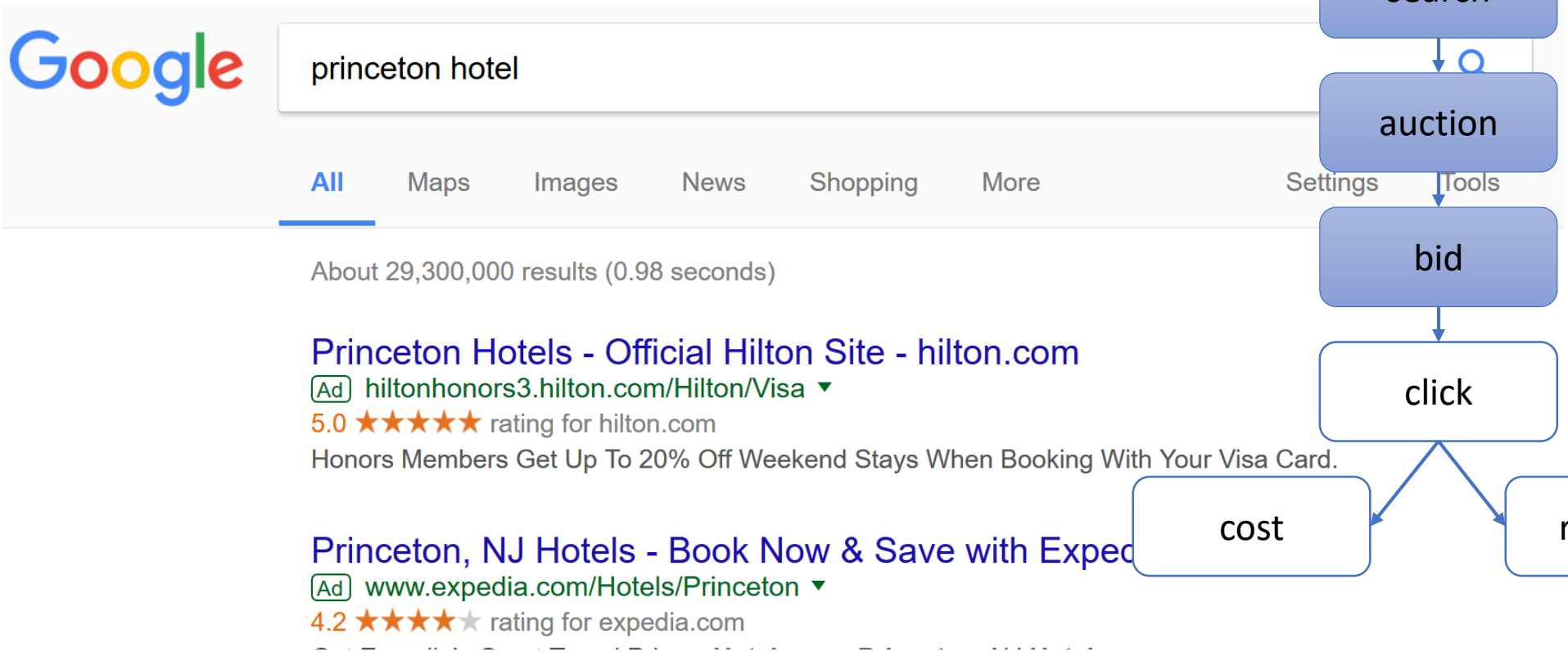


- Advertisers bid to get their ads placed



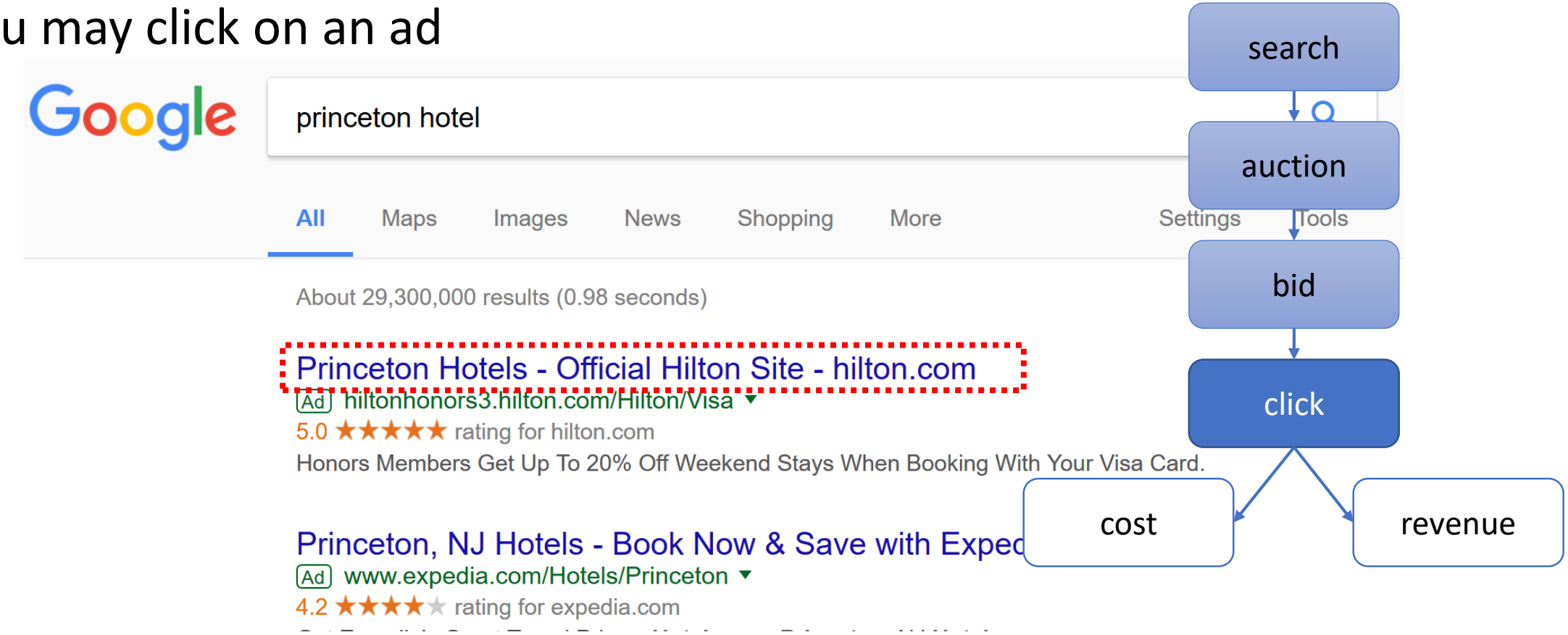
How to Bid in SSA

- The ads from the winners appear in the result



How to Bid in SSA

- You may click on an ad

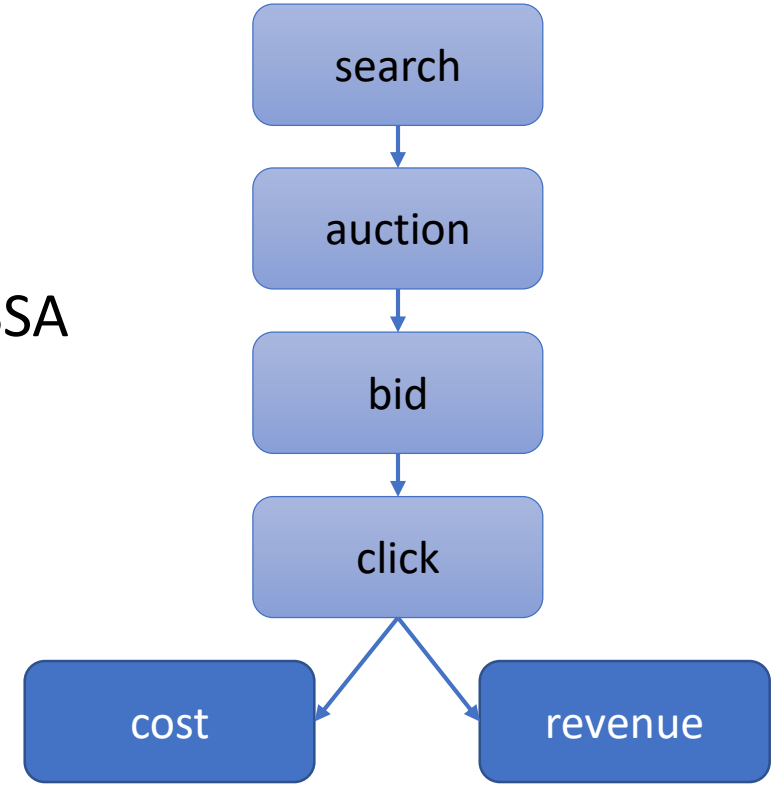


How to Bid in SSA

- Then that advertiser pay for your click
- You may generate some revenue for that advertiser
- Profit of a bid = [revenue] – [cost]

Learn How to Bid in SSA

- Learning with a goal: maximize profit
- Find the policy
  - that maximizes profit from bidding (to advertise) in SSA



Simulator Description

Discrete-time Simulator

- Time runs in discrete steps
  - Simulator's 1 step = real-world 1 hour
  - $t = 0, 1, \ldots, T$

- At time t,
  - Each policy will submit their bid
  - Bid is valid for $[t, t+1)$, fixed during that time step
  - May change bids at $t+1$

Second Price Auction

- Highest bidder wins the auction
- Highest bidder gets to put on the ad
- When the ad is clicked, the ad owner pays the second highest bid

- Example
  - Bid: $3, $5, $6, $10
  - Winner: D
  - Per click, D pays $6

Many Auctions at a Timestep

- Many searches can happen in 1 hour
- Many auctions can happen in 1 timestep

- Note: your bid is fixed for each timestep

- Tie-breaking? Fair deal.
  - Highest bid ties will be randomly broken
  - If all bids tie, then the winners will pay the bid price (not 2nd highest bid)

Not All Auctions Are the Same

- Each auction has different set of attributes
  - e.g. my search = age 30-39, gender M, platform desktop, location NJ+suburb

- Attribute Space (tentative)
  - Age: 0-19, 20-29, 30-39, 40-49, 50-59, 60+
  - Gender: M, F
  - Platform: Mobile, Tablet, Desktop
  - Location: Geo+Type

Attribute-specific Bidding

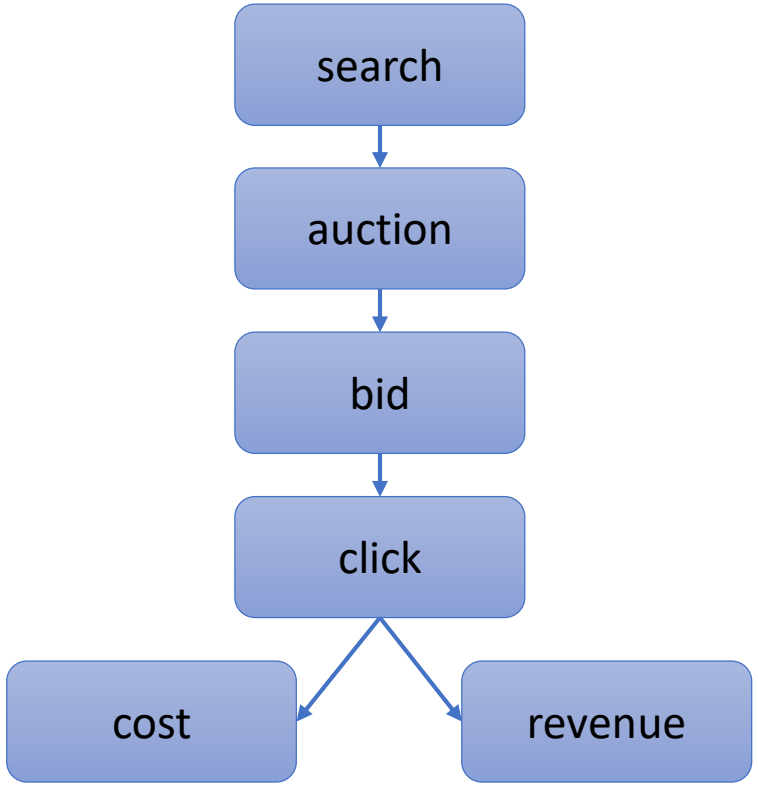
- For each attribute, you may bid differently
  - bid() function in your policy

Learning to Bid

- Bidding policy can learn from outcome
  - learn() function in your policy
- Information is provided every iteration
  - Your policy can learn and change bidding strategy for the next iteration

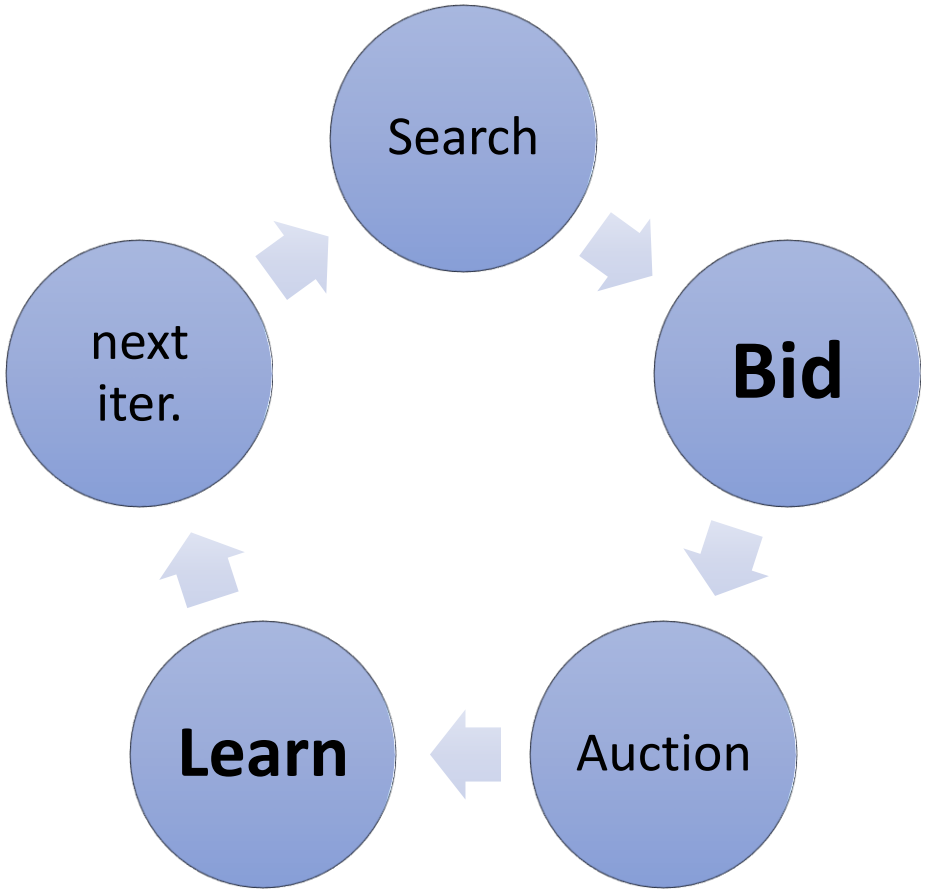
Simulator Operation

- For each auction
  - Get bids from each policies
  - Determine winner
  - Randomly determine click counts
  - Compute cost per click
  - Randomly determine conversion & revenue
  - Report individualized results to each policies



Simulator Operation: Policy's View

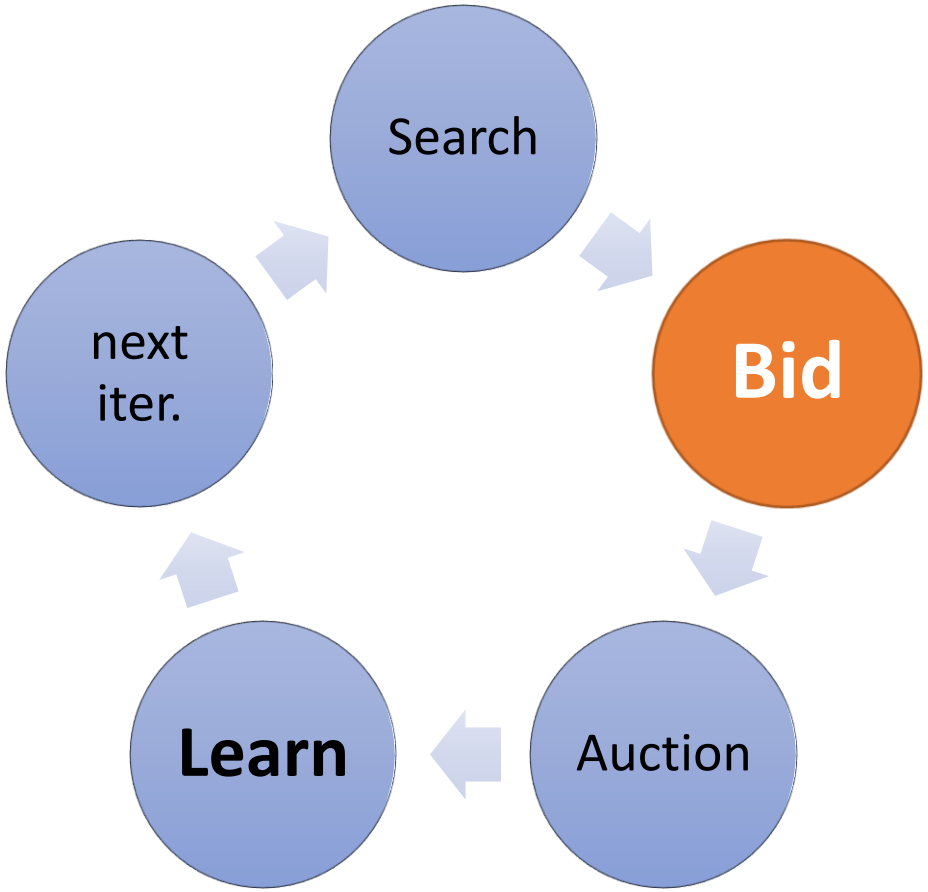
- For each iteration, each policy
  - Sends in bids
  - Gets the results & learn



Code Structure

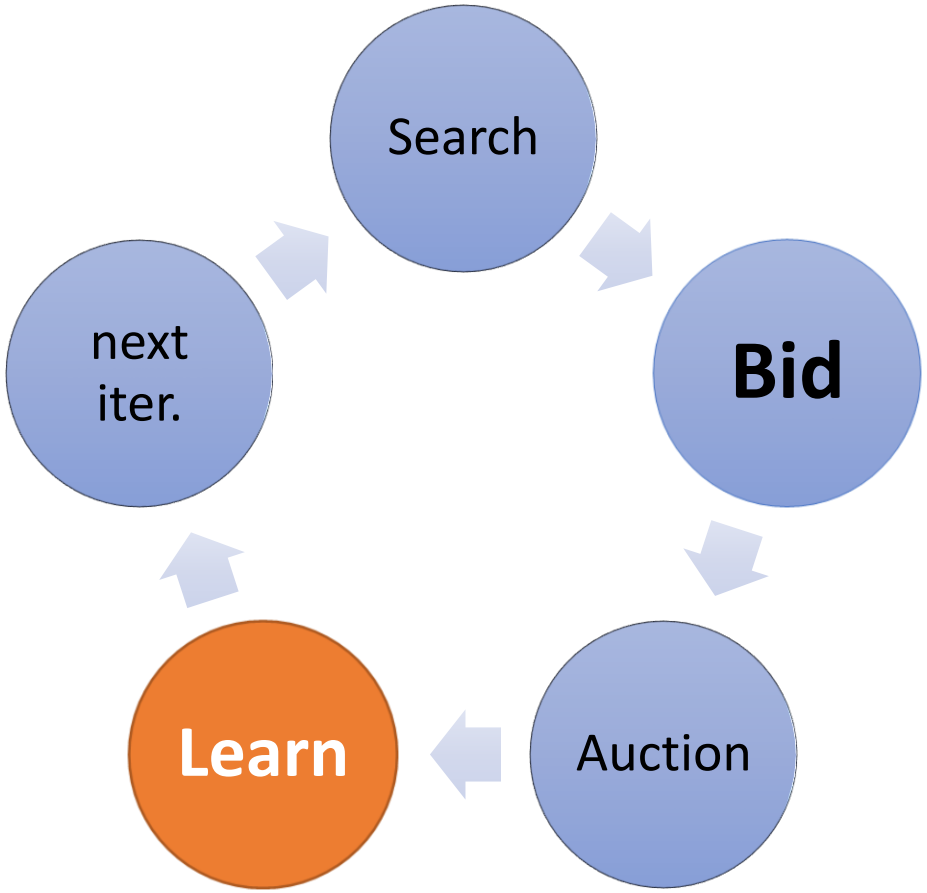
Policy.bid()

- For each iteration, each policy
  - Sends in bids
  - Gets the results & learn
- Function bid()



Policy.learn()

- For each iteration, each policy
  - Sends in bids
  - Gets the results & learn
- Function learn()



Simulator Operation, Revisited

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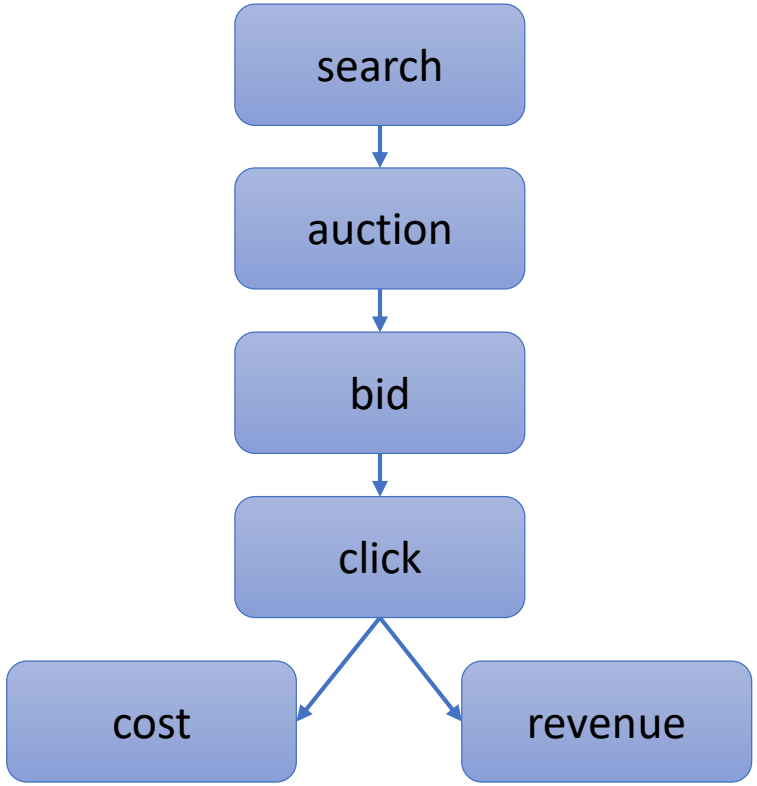
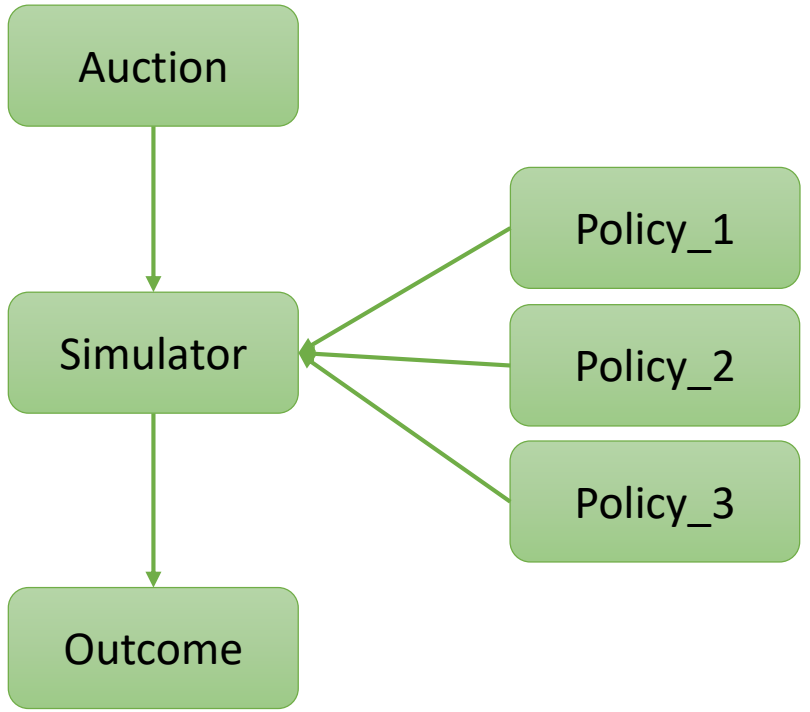


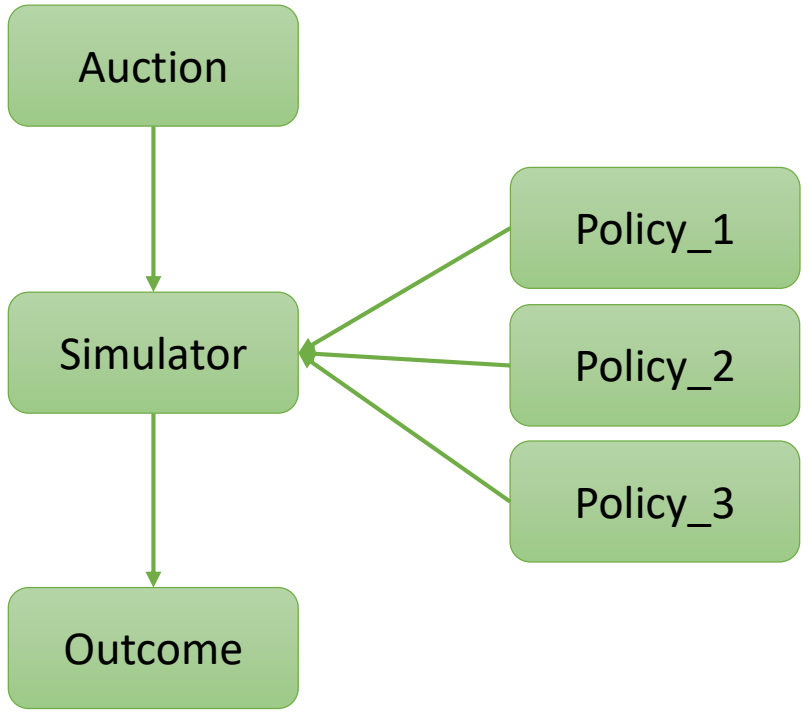
Simulator Code Structure

- Auctions are pregenerated
  - For all possible attributes



Simulator Code Structure

- Auctions are pregenerated
  - For all possible attributes
- For each iteration t
  - For each auction attribute a
    - Get bid from each policy



Simulator Code Structure

- Auctions are pregenerated
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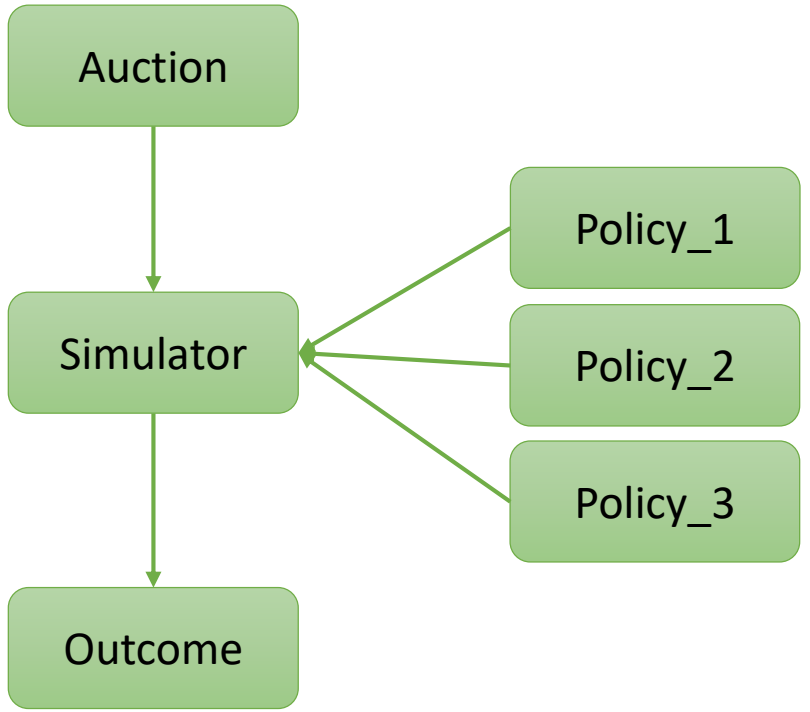

Simulator Code Structure

- Auctions are pregenerated
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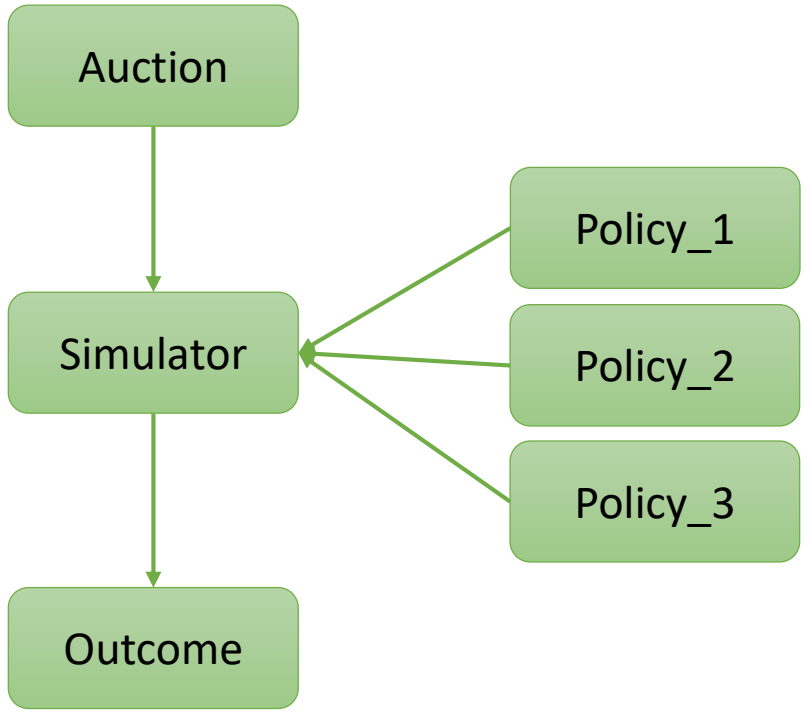
- For each iteration t
  - For each auction attribute a
    - Get bid from each policy
  - Each policy learns from result
- Outcome is packed as xlsx



Dive to Code