

Intro to Ad-Click Simulator

Castle Lab @ Princeton U.

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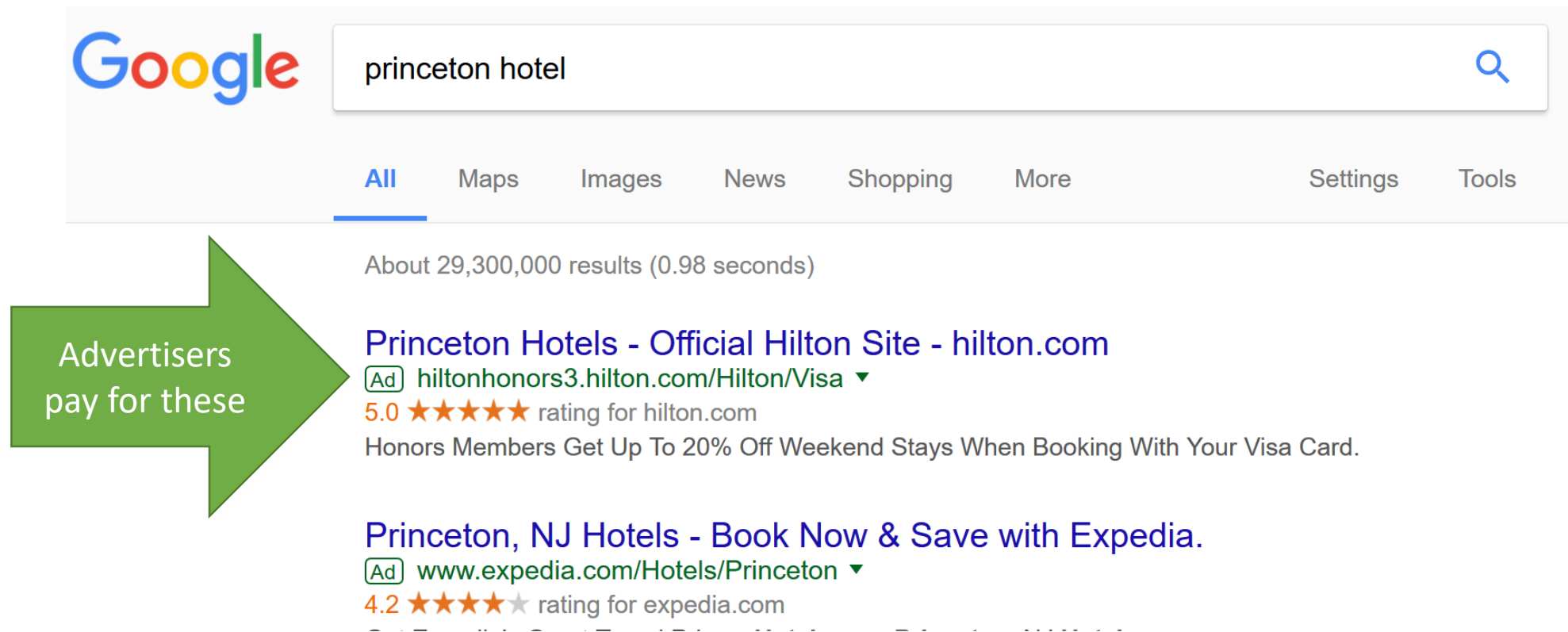
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1. Sponsored Search Auction
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Sponsored Search Auction

Sponsored Search Auction (SSA)

- Sponsored search auction result



The image shows a Google search interface for the query "princeton hotel". The search bar is at the top with the Google logo on the left and a search button on the right. Below the search bar are tabs for "All", "Maps", "Images", "News", "Shopping", "More", "Settings", and "Tools". The "All" tab is selected. Below the tabs, it says "About 29,300,000 results (0.98 seconds)".

Two sponsored search results are displayed:

- Princeton Hotels - Official Hilton Site - hilton.com**
An advertisement for Hilton Hotels. It includes a green "Ad" label, the URL "hiltonhonors3.hilton.com/Hilton/Visa", a 5.0 star rating, and the text "Honors Members Get Up To 20% Off Weekend Stays When Booking With Your Visa Card."
- Princeton, NJ Hotels - Book Now & Save with Expedia.**
An advertisement for Expedia. It includes a green "Ad" label, the URL "www.expedia.com/Hotels/Princeton", and a 4.2 star rating.

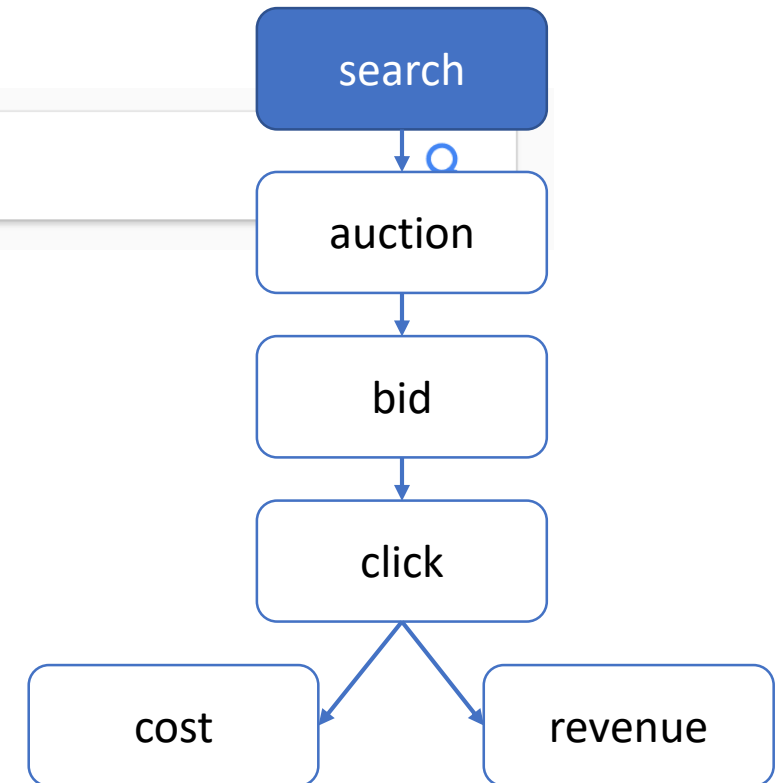
A green arrow points from the text "Advertisers pay for these" to the sponsored search results.

How to Bid in SSA

- When someone sends in a search query



princeton hotel



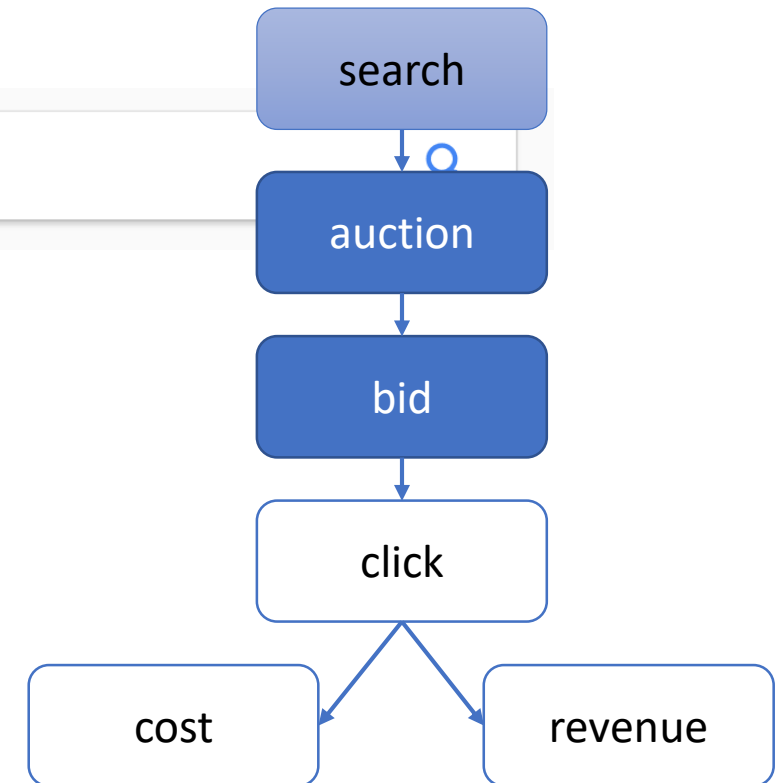
How to Bid in SSA

- Auction happens behind the curtain



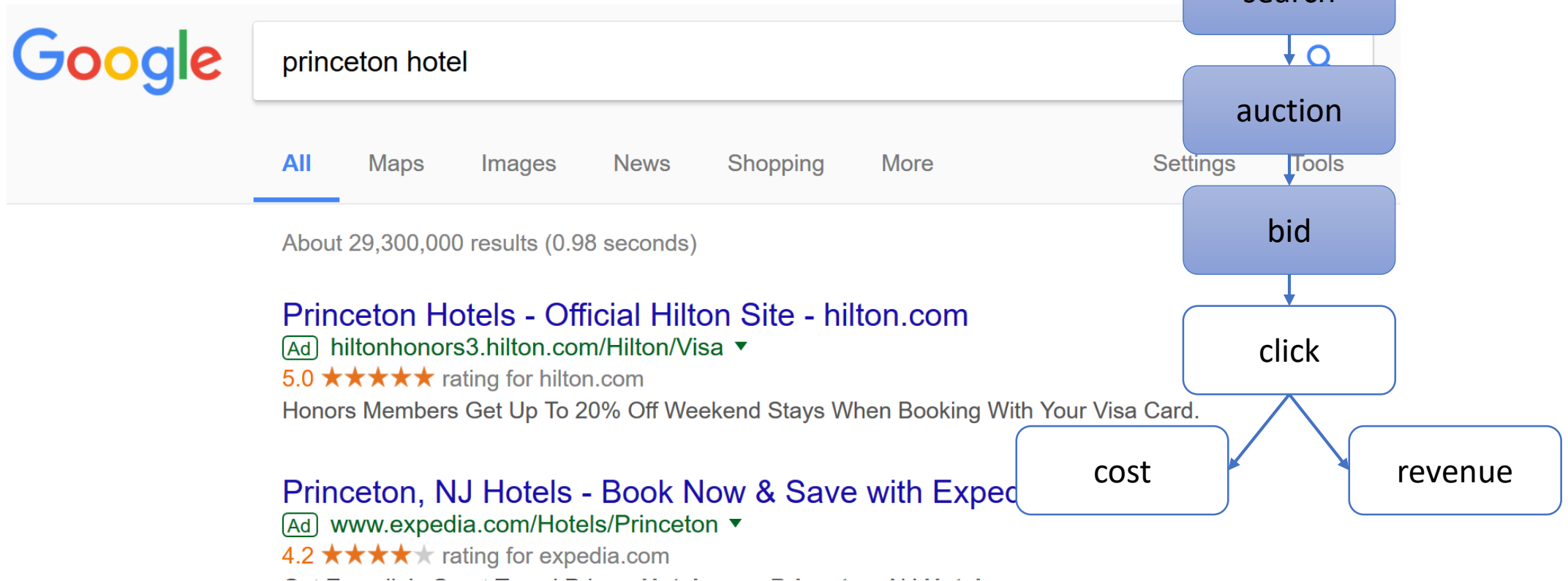
princeton hotel

- Advertisers bid to get their ads placed



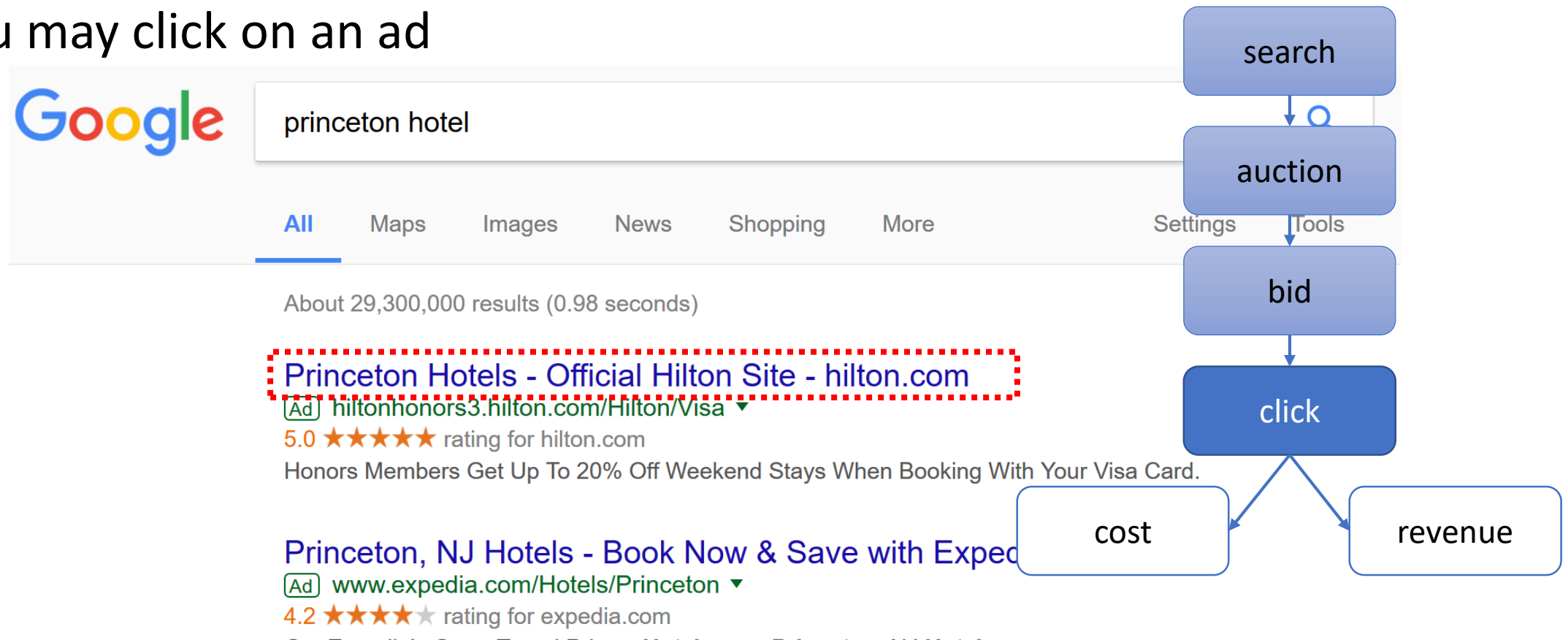
How to Bid in SSA

- 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

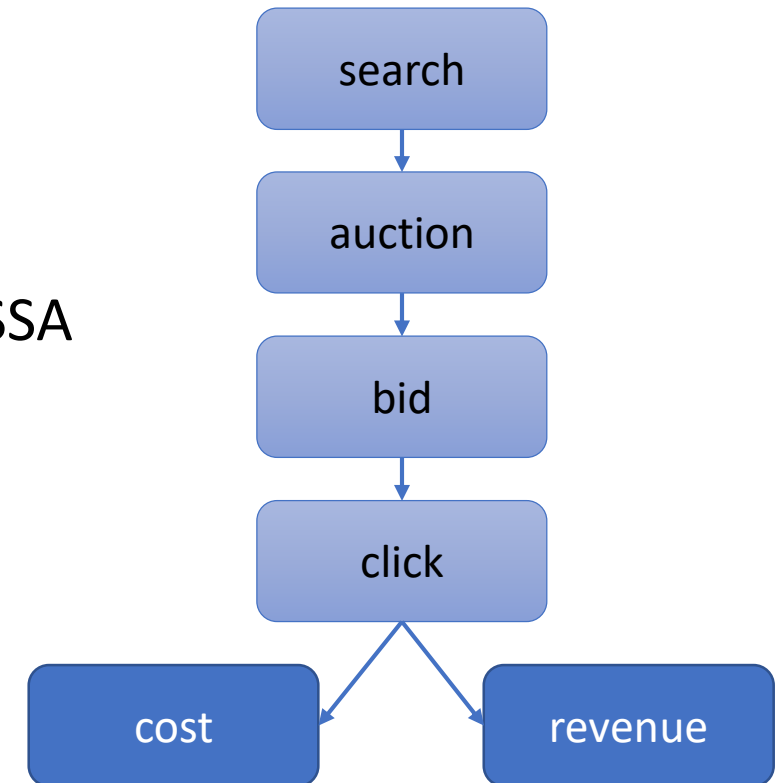
- You may generate some revenue for that advertiser



- 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
 - $t = 0, 1, \dots, T$
- 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

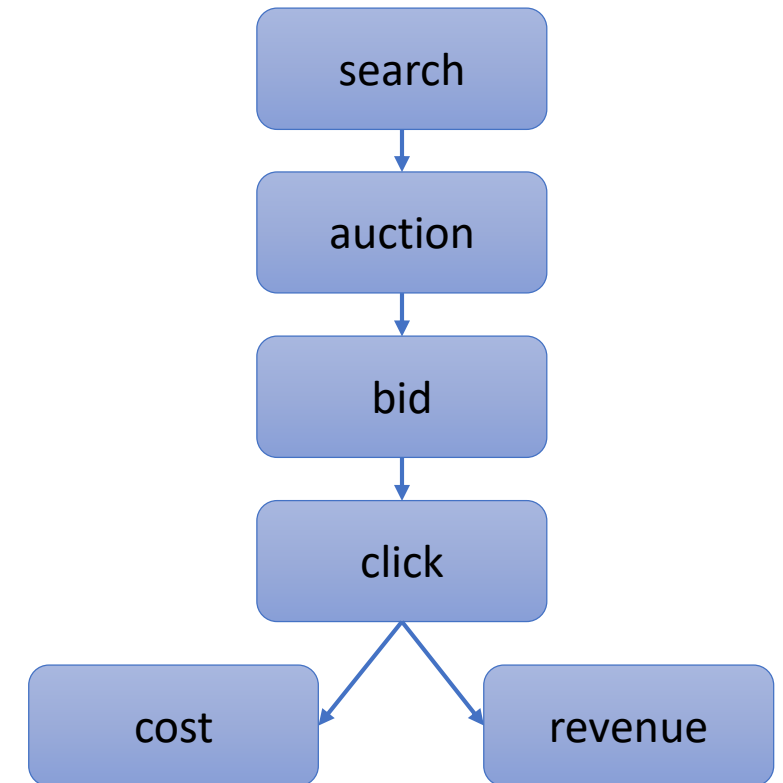
- For each attribute, you may bid differently
 - `bid()` function in your policy

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

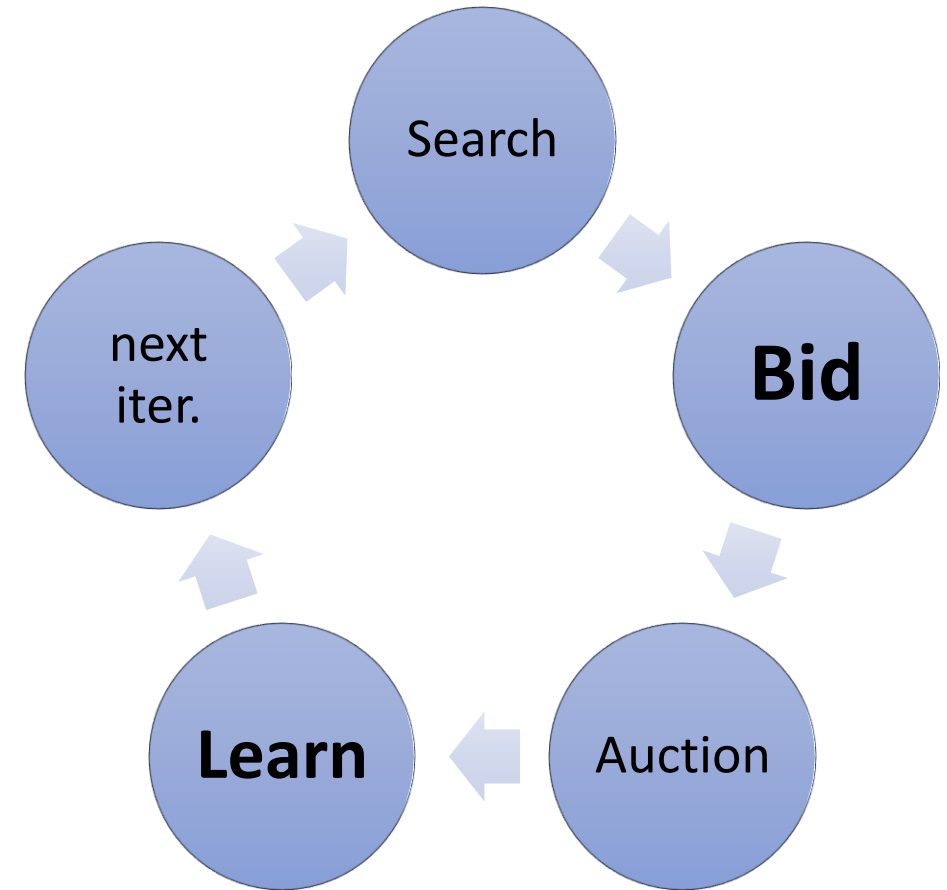
Simulator Operation

- 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

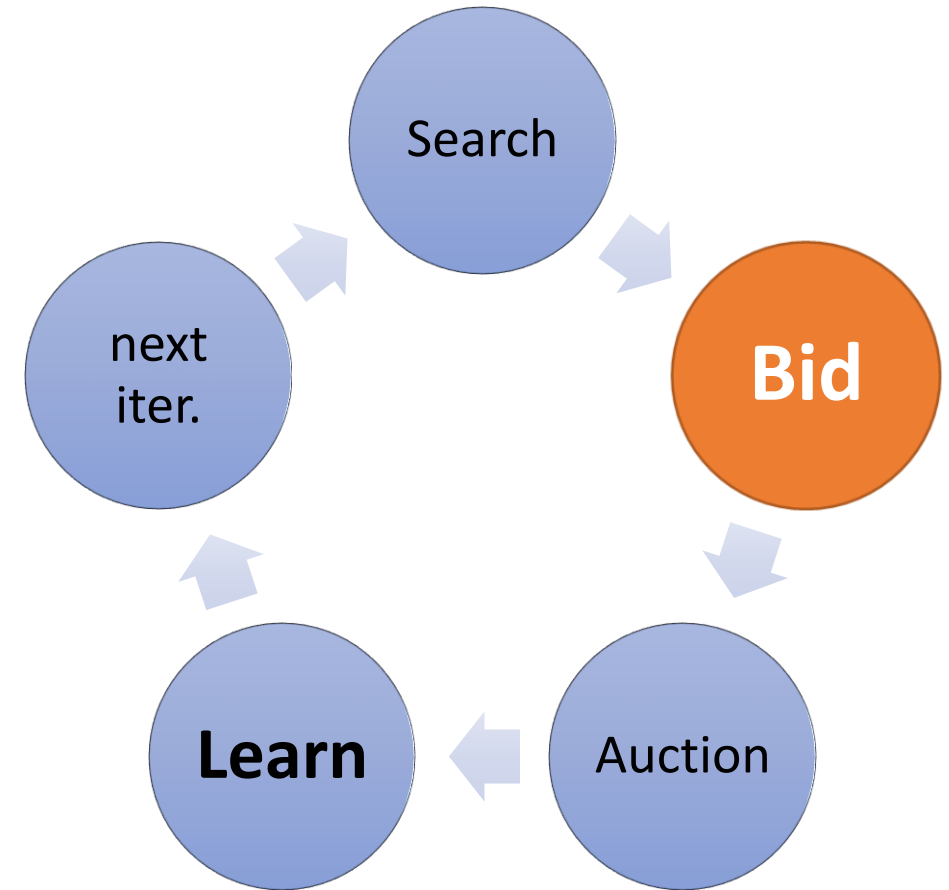
- For each iteration, each policy
 - Sends in bids
 - Gets the results & learn



Code Structure

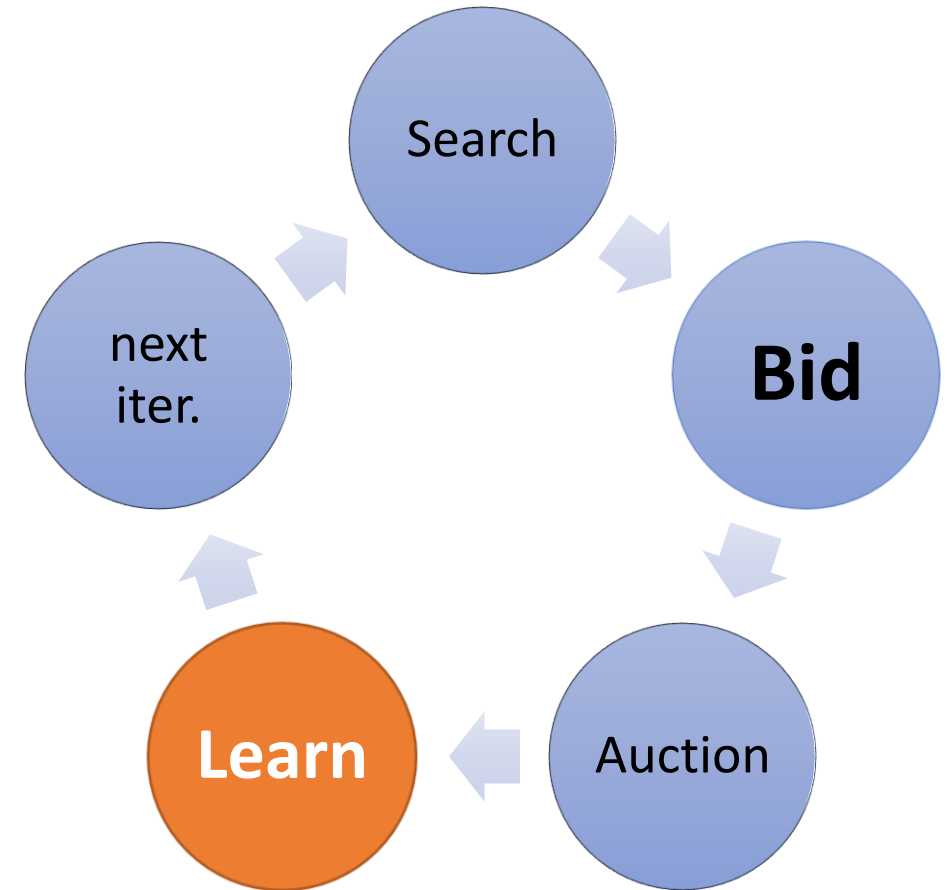
Policy.bid()

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



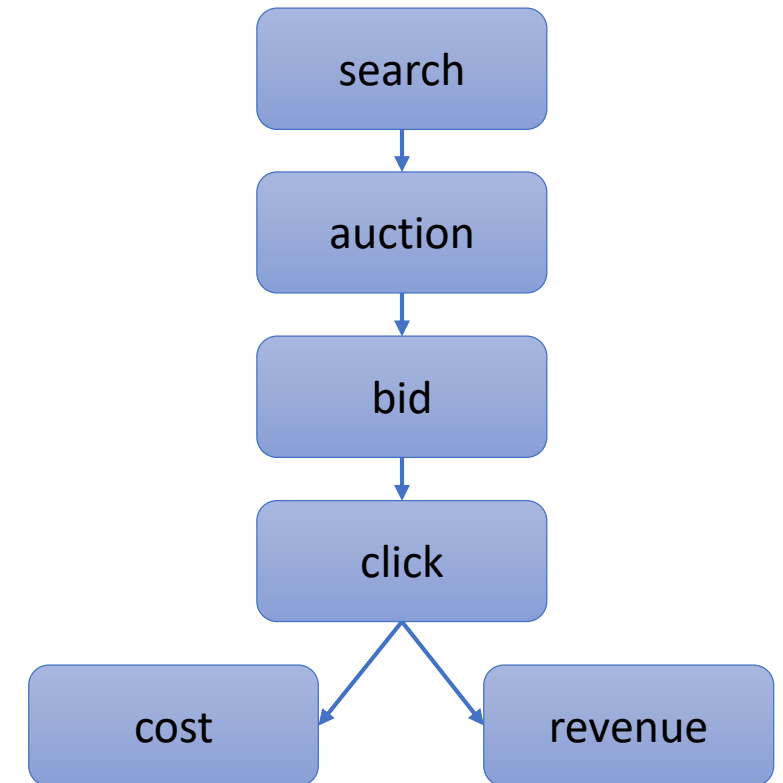
Policy.learn()

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



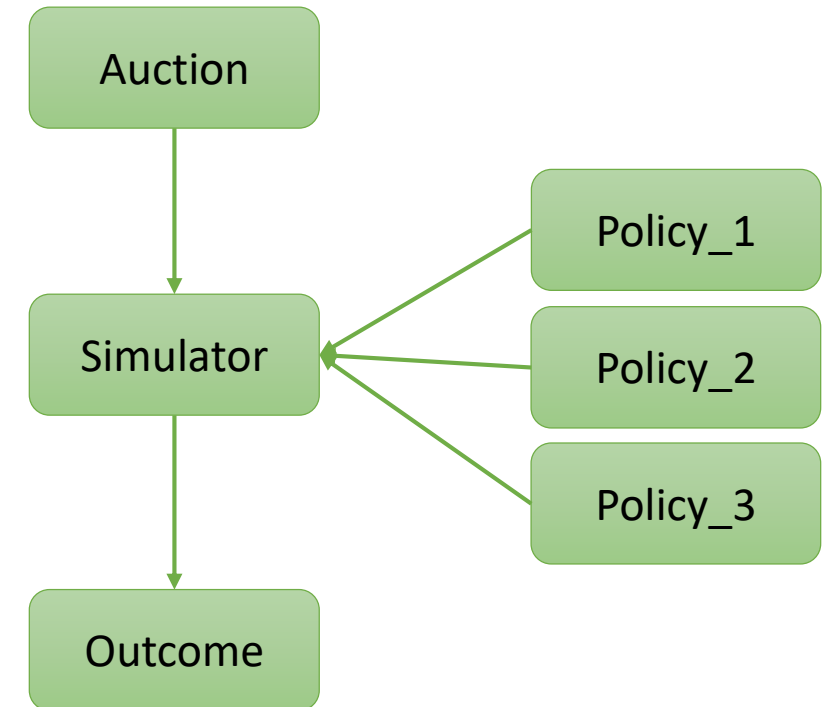
Simulator Operation, Revisited

- For each auction
 - Get bids from each policies
 - Determine winner
 - Randomly determine click counts
 - Compute cost per click
 - Randomly determine conversion & revenue
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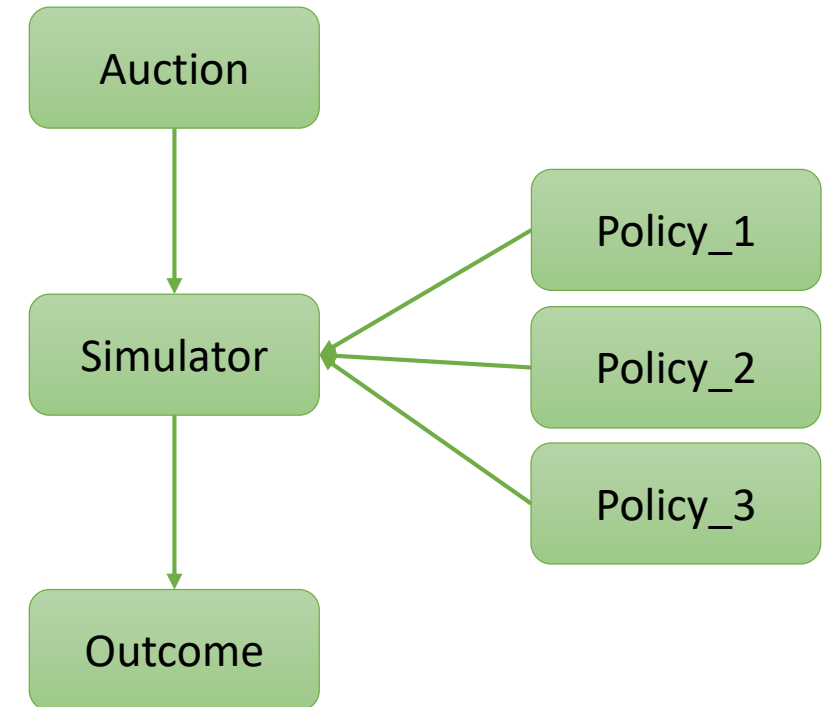
Simulator Code Structure

- Auctions are pregenerated
 - For all possible attributes



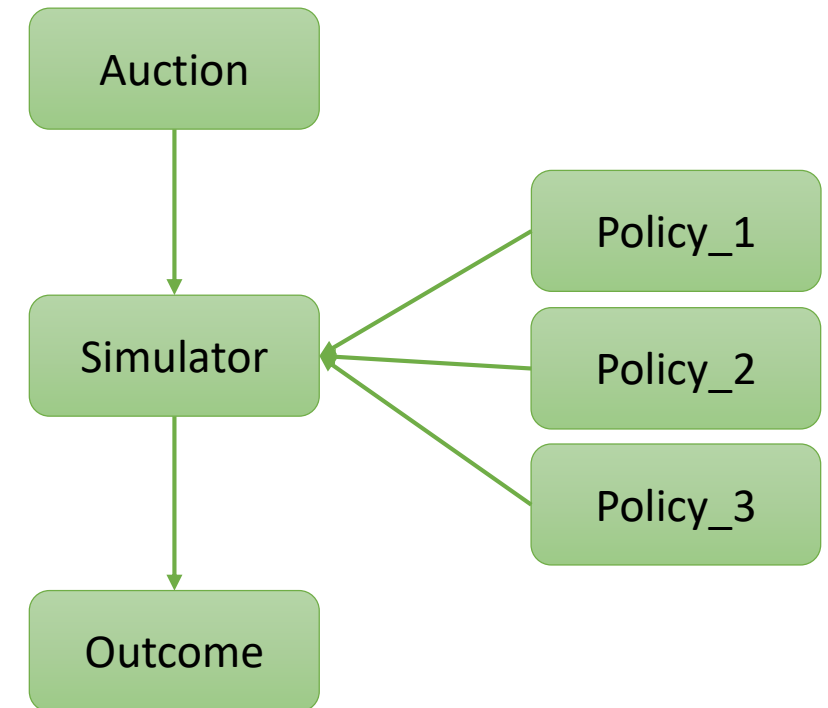
Simulator Code Structure

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



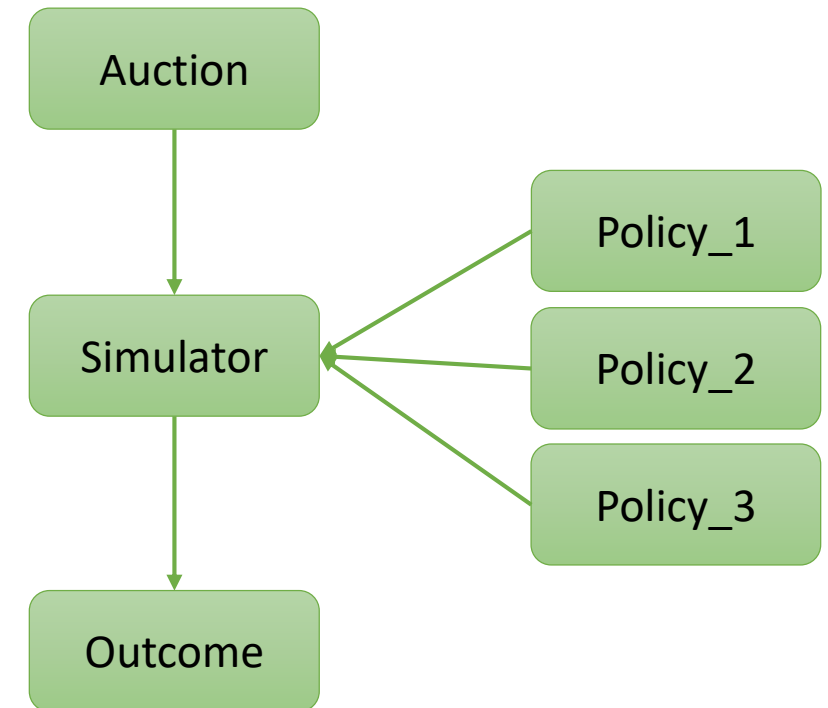
Simulator Code Structure

- Auctions are pregenerated
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- For each iteration t
 - For each auction attribute a
 - Get bid from each policy
 - Each policy learns from result



Simulator Code Structure

- Auctions are pregenerated
 - For all possible attributes
- 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