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Assignment 6: Sponsored Search Auctions

#1 Designing a bidding agent

Coded in the sothbybb.py. Agent name: SothbyBB.

#2 Experimental Analysis

(a)What is the average utility of a population of truthful agents? What is the average utility of a population of balanced bidding agents? Compare the two cases and explain your findings.

python auction.py --perms 1 --seed 2 --iters 200 Truthful,5
python auction.py --perms 1 --seed 2 --iters 200 SothbyBB,5

Truthful	Balanced-bidding Agent
AU(Agent 0) = \$372.85	AU(Agent 0) = \$1016.99
AU(Agent 1) = \$317.86	AU(Agent 1) = \$587.91
AU(Agent 2) = \$339.20	AU(Agent 2) = \$712.93
AU(Agent 3) = \$368.27	AU(Agent 3) = \$778.17
AU(Agent 4) = \$329.75	AU(Agent 4) = \$720.63
Ave. Utility = \$345.586	Ave. Utility = \$763.326

The average utility of a population of balanced-bidding agents is much higher than truthful agents. The reason of the gap is that a balanced-bidding agents is trying to maximize their utility by lowering the cost of get the position that has the highest cost-performance ratio when truthful agents always report their true value.

(b)In addition, what is the average utility of one balanced-bidding agent against 4 truthful agents, and one truthful agent against 4 balanced-bidding agents? For the new experiment, make use of the --seed, and --iters commands, but you will now want to run multiple permutations. What does this suggest about the incentives to follow the truthful vs. the balanced bidding strategy?

python auction.py --perms 10 --seed 2 --iters 200 Truthful,4 SothbyBB,1
python auction.py --perms 10 --seed 2 --iters 200 Truthful,1 SothbyBB,4

4 Truthful, 1 Balanced-bidding	1 Truthful, 4 Balanced-bidding

AU(Truthful Agent 0) = $432.02	AU(Truthful Agent 0) = $1174.63
AU(Truthful Agent 1) =$434.69	AU(Balanced-bidding Agent 1) = $814.26
AU(Truthful Agent 2) = $427.19	AU(Balanced-bidding Agent 2) = $820.24
AU(Truthful Agent 3) = $409.13	AU(Balanced-bidding Agent 3) = $822.44
AU(Balanced-bidding Agent 4) = $278.49	AU(Balanced-bidding Agent 4) = $814.40

In both 4 truthful, 1 balanced-bidding game and 1 truthful, 4 balanced-bidding game, balanced-bidding agent(s) outperform truthful agent(s).

In 4 truthful, 1 balanced-bidding game, when balanced-bidding agents is trying to get the highest cost-performance ratio when truthful agents always report their true value. Since truthful agents never retaliate and the price remains high, the balanced-bidding agents can not benefit from its strategy by bidding lower since the bids placed by other truthful bidders won't change.

In 1 truthful, 4 balanced-bidding game, since 4 balancing-bidding agents keep retaliating and lower the prices of positions and this game uses GSP mechanism, the payment to get targeted position of truthful agents would be lower by other balanced-bidding agents and it raises truthful agent's utility.

Therefore, if I'm bidding with a group of truthful agents, I should follow balanced-bidding strategy to take advantage on the truthful bid. If I'm bidding with a group of balanced-bidding agents, I should adopt truthful strategy to take advantage on the low price caused by balanced-bidding agents' retaliation.

#3 Auction Design and Reserve Prices

(a) Complete the code that runs the VCG.

Coded in vcg.py.

(b) What is the auctioneer's revenue under GSP with no reserve price when all the agents use the balanced-bidding strategy? What happens as the reserve price increases? What is the revenue-optimal reserve price?

Command: --perms 1 --seed 2 --iters 200 --mech=gsp & --reserve from 0 - 60 & SothbyBB,5

Reserve Price	Revenue
0	$4189.20 (std:$1630.29)
20	$4595.61 (std:$1385.29)
30	$4736.14 (std:$1478.42)

40	$4872.55 (std:$1452.18)
45	$4824.09 (std:$1553.59)
50	**$4924.95 (**std:**$1552.15)**
55	$4795.65 (std:$1751.29)
60	$4871.40 (std:$1763.24)
70	$4774.49 (std:$1958.71)

When all agents adopt balanced-bidding strategy, under GSP mechanism and without reserve price (reserve price = 0), the average daily revenue of auctioneer is $4189.20 with standard deviation $1630.29. As the reserve price increase, the average revenue also increases, hits maximum at reserve price $50, and then generally decreases. The revenue-optimal reserve price is 50 which leads to average daily revenue of $4924.95.

(c) What is the auctioneer's revenue under VCG with no reserve price when all agents are truthful? What happens as the reserve price increases? Explain your findings and compare with the results of part (b).

Command: --perms 1 --seed 2 --iters 200 --mech=vcg & --reserve from 0 - 120 & Truthful,5

Reserve Price	Revenue
0	$4231.64 (std: $1220.41)
20	$4231.64 (std $1220.41)
30	$4270.93 (std: $1307.98)
40	$4446.27 (std: $1079.27)
50	$4634.40 (std: $1210.92)
60	$4661.68 (std: $1106.69)
70	$4897.41 (std: $1188.77)
80	$5115.31 (std: $1422.16)
83	$5033.79 (std: $1408.99)

84	$5084.87 ($1384.32)
85	**$5205.05 (std: $1361.34)**
90	$5041.38 (std: $1561.15)
100	$4997.27 (std: $1795.65)
110	$5047.89 (std: $2113.02)
120	$4630.32 (std: $2122.53)

When all agents adopt truthful strategy, under VCG mechanism and without reserve price (reserve price = 0), the average daily revenue of auctioneer is $4231.64 with standard deviation of $1220.41. The daily revenue is low when the reserve price is low or really high (larger than 100). The optimal reserve price is 85. The optimal reserve price of VCG is lower than that in GSP. In [0, 60] interval of reserve price, the revenue of every envy-free Nash equilibrium of GSP is dominating that of the VCG position auction.

(d) Fix the reserve price to zero. Explore what might happen if a search engine switched over from the GSP to VCG design. For this, run the balanced-bidding agents in GSP, and at period 24, switch to VCG, by using the --mech=switch parameter. What happens to the revenue?

python auction.py --perms 1 --seed 2 --iters 200 --mech=switch --reserve 0 SothbyBB,5

The average daily revenue by switching from the GSP to VCG at period 24 is $3128.92, which is much smaller than the revenue of envy-free GSP outcome and the truthful VCG outcome.

(e) In one paragraph, state what you learned from these exercises about agent design, auction design, and revenue?

If I'm auctioneer, in order to maximize the revenue, I should design my system with GSP mechanism. In GSP mechanism, agents should adopt balanced-bidding strategy in order to maximize utility. In VCG mechanism, balanced-bidding agents and truthful agents will perform similarly since spiteful NE of the GSP and the VCG is equivalent. Meanwhile, as auctioneer with the GSP, I should not set the reserve price too low or too high.

#Budget Constrains

(a) In TEAMNAMEbudget.py, write your competition agent. Describe in a few sentences how it works, why it is designed this way, and how you expect it to perform in the class competition.

In the early and later periods in the game when the clicks of position are high, my agent will adopt truthful bidding strategy in order to get the top position. In the mid periods, around t=24, when the clicks are few, my agent would bid slight higher than the reserve price, I do so in order to save budget for later round. In other time periods, my agent adopts balanced-bidding strategy. I expect my agent can get the top position in later periods.

(b) Win the competition.

Depend on the tournament result.