Exercise 5: An Auctioning Agent for the Pickup and Delivery Problem

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1 Bidding strategy

As we know we will have at least 10 tasks, we adopted a strategy that basically tries to obtain a maximal number of the 10 first tasks. Indeed, having several tasks at the beginning enable us to use our planner in order to reduce the cost of new tasks in auction, and so to bid low prices with positive benefices.

Obtaining firsts tasks requires to bid low prices, which have as an effect to make negative benefices. We then hope to use our planner in order to quickly compensate this deficit. In order to safely bid these negative-benefice low prices, we roughly estimate the average cost $\overline{Cost}(N_T)$ of one task given N_T tasks in plan. The idea is that biding $\overline{Cost}(N_T)$ N_T times should bring null benefices in average. So, bidding $\overline{Cost}(10)$ is quite safe for the 10 first auctions. But still not low enough to guaranty winning enough tasks. We hence take a risk with $\overline{Cost}(20)$:

$$B_s = \overline{Cost}(20) = \frac{1}{N_s} \sum_{N_s} Cost(P_{20})$$

where P_{20} is a plan containing 20 random tasks, optimised with our planner's heuristic. Bidding B_s is our *starting* strategy.

Then, at each auction of task T, we assume this is the last auction and we bid a marginal price B_m given our plan P_{own} and the estimated plan of the adversary $P_{adversary}$, plus a constant low margin $B_p > 0$ which ensure our positive benefices:

$$B_m = \frac{C_m(T|P_{own}) - C_m(T|P_{adversary})}{2} + B_p$$

where $C_m(T|P)$ is the marginal cost for a task T with a plan P:

$$C_m(T|P) = \max(Cost(P \cap T) - Cost(P), 0)$$

We estimate $C_m(T|P_{adversary})$ as an average over N_a possible adversary's plan optimized with our own planner's heuristic. Bidding B_m is our *marginal* strategy. In fact, as the game can end after only 10 tasks or as we may want to continue bidding in deficit if we don't win enough tasks, we don't use B_s 10 times and then B_m till the end, but we smoothed this transition by bidding:

$$B_\gamma = (1 - \gamma)B_s + \gamma B_m$$

with:

$$\gamma = \frac{1}{1 + \exp(\frac{10-i}{2})}$$

i being the number of realised auctions.

2 Results

2.1 Experiment 1: Comparisons with dummy agents

2.1.1 Setting and Observations

We compared our agent to three different dummy agents:

- `Uniform` always bids the same value fixed to be 750
- `Random` bids a random value chosen uniformly between 500 and 1500

We used the default parameters from `auction.xml` with random seed `123456` and either 10 or 25 tasks. Our agent ended with higher gain on all 4 cases.

2.2 Experiment 2

2.2.1 Setting and Observations

We compare it to another dummy agent `Marginal` which bids exactly the marginal cost of the available task. Our agent loses for 10 available tasks, but wins for 25 available tasks. This is due to the fact that our agent plans too long ahead in the future. If we reduce the parameter for evaluating the average cost of tasks from 20 to 10, our agent performs better on the short sequence of tasks and beats the `Marginal` agent.