Hyuga Matsuo Hiroyasu Yoshino Yuji Kobayashi Takumu Shimizu Ryota Arakawa Shota Takayama

KanbeAgent

Masato Kijima
Tokyo University of Agriculture and Technology
Katsuhide Fujita Lab.

東京農工大学

ハッケン コウケン
Tokyo University of Agriculture and Technology

Contents

Concepts

- Contracts with multiple agents
  - KanbeAgent rarely conclude an exclusivity agreement with one agent
  - KanbeAgent sets the quantity range of proposals and acceptances
- Make concessions according to a negotiation step and n^{rm}
  - KanbeAgent weighs a unit price in the first half of the negotiation
  - KanbeAgent weighs a quantity in the second half of the negotiation

n^{rm} : the number of partners KanbeAgent can negotiate

Setting the Quantity Range

- Set the range of the target number of contracting partners

$$n_s^{mxto} = \begin{cases} \frac{3}{4}n^{ap} - n_s^c & n_s^{fo} < \frac{1}{4}n^{ap} \\ n_s^{remain\_ptr} & \text{otherwise} \end{cases}$$

$$n_s^{mnto} = \begin{cases} \frac{1}{2}n^{ap} - n_s^c & n_s^{fo} < \frac{1}{2}n^{ap} \\ max(1, \frac{1}{4}(\frac{1}{2}n^{ap} - n_s^c + n_s^{mxto})) & \frac{1}{2}n^{ap} < n_s^c \\ n_s^{remain\_ptr} & \text{otherwise} \end{cases}$$

n^{ap} : the number of all negotiation partners
n_s^c : the number of all agreements by step s
n_s^{fo} : the number of all finished partners by step s

Setting the Quantity Range

- Set the range of quantities KanbeAgent handles

$$q_{trades}^{max} = min(q^{max}, \frac{q^{need}}{n_s^{mnto}})$$

$$q_{trades}^{min} = max(q^{min}, \frac{q^{need}}{n_s^{mxto}})$$

q^{max} : the maximum quantity of the negotiation issues
q^{min} : the minimum quantity of the negotiation issues
q^{need} : the quantity of its needs

Offering Strategy : Price

- Consider p^a_{s-1}, s, and the number of opponents
  - p^a_{s-1} : the price of the last offer from the agent a
  - s : the negotiation step
- Decides by TF

$$p^{offer}_{s,a} = \begin{cases} p^{best} & \text{TF} = 0 \text{ or } p^a_{s-1} = p^{best} \\ p^{worst} & \text{TF} = 1 \end{cases}$$

$$TF = \begin{cases} 1 & \frac{1}{4} n^{ap} \leq n^{fo}_s \text{ or } \frac{3}{4} n^{ap} \leq n^c_s \\ 0 & \text{otherwise} \end{cases}$$

n^{ap} : the number of all negotiation partners
n^c_s : the number of all agreements by step s
n^{fo}_s : the number of all finished partners by step s

$$p^{best} = \begin{cases} p^{max} & \text{if selling} \\ p^{min} & \text{if buying} \end{cases}, \quad p^{worst} = \begin{cases} p^{min} & \text{if selling} \\ p^{max} & \text{if buying} \end{cases}$$

p^{max} : the maximum unit price of the negotiation
p^{min}: the minimum unit price of the negotiation

Offering Strategy : Quantity

- Propose within the quantity range
- Consider the opponent last offer
- Change our strategy depending on the negotiation step
  - Propose the bids with high quantity($s < 5$)

$$q_{s,a}^{offer} = \begin{cases} quantity & p_{s-1}^{a} = p^{worst} \\ max(min(quantity, q_{s-1}^{a}), q_{trades}^{min}) & \text{otherwise} \end{cases}$$

$$quantity = min(q^{need}, max(\frac{1}{2}q^{max}, q_{best\_price}^{opp}))$$

Offering Strategy : Quantity

- Reduce the quantity with rounds elapsed $(5 \leq s < TT)$

$$q^{offer}_{s,a} = \begin{cases} max(min(q^a_{s-1}, q^{need}), q^{min}_{trades}) & p^a_{s-1} = p^{best} \\ max(q^{min}_{trades}, min(quantity, q^a_{s-1})) & p^{offer}_{s,a} = p^{worst} \\ max(min(q^{max}_{trades}, q^a_{s-1}), q^{min}_{trades}) & p^a_{s-1} = p^{worst} \end{cases}$$

$$quantity = \begin{cases} q^{offer}_{s-1,a} - 1 & q^{offer}_{s-1,a} > q^{min}_{trades} \\ q^{min}_{trades} & \text{otherwise} \end{cases}$$

- Propose the bids with low quantity$(TT \leq s)$

if: $TT \leq s < 18$

$$q^{offer}_{s,a} = \begin{cases} min(q^{need}, q^a_{s-1}) & q^{max}_{trades} < q^a_{s-1} \\ max(min(q^{max}_{trades}, q^a_{s-1}), q^{min}_{trades}) & \text{otherwise} \end{cases}$$

elif: $18 \leq s$

$$q^{offer}_{s,a} = min(q^{min}_{trades}, q^a_{s-1})$$

$TT = 20 - q^{need}$

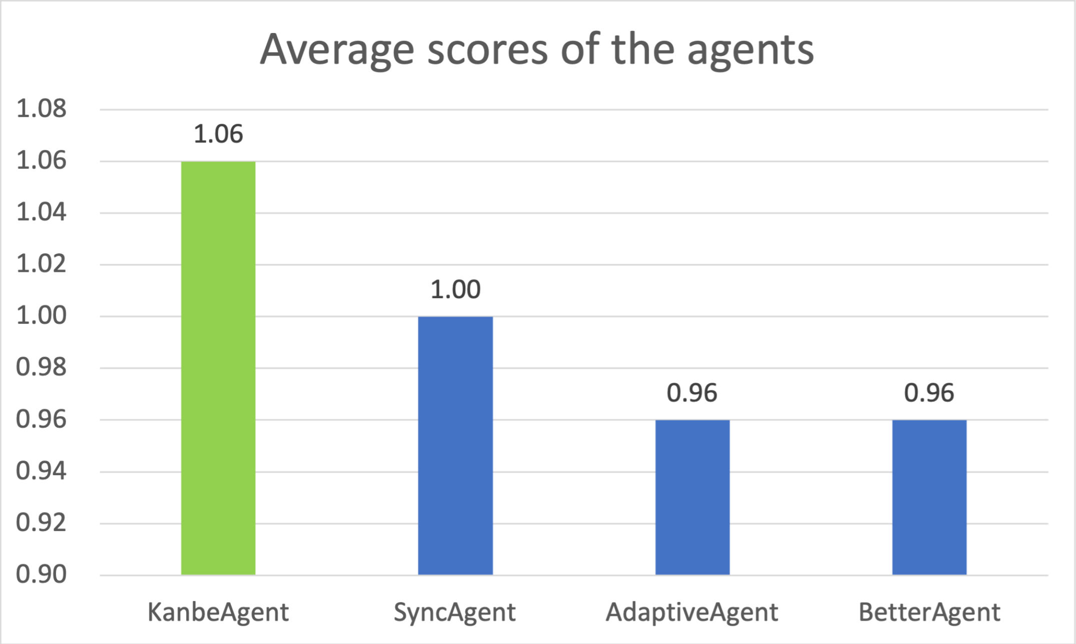
Acceptance Strategy

- Accept under the following conditions
  - if $p^a = p^{best}$
    - if $q_{trade_s}^{min} \leq q^a \leq q^{need}$ when $s \leq 17$
    - elif $q^a \leq q^{need}$ when $18 \leq s$
  - if $p^a = p^{worst}$
    - if $q_{trade_s}^{min} \leq q^a \leq q^{need}$ and $(p_{last}^{offer}$ or $p_{next}^{offer} = p^{worst})$ when $s < TT$
    - elif $q_{trade_s}^{min} \leq q^a \leq q^{need}$ when $\mathrm{TT} \leq s < 18$
    - elif $q^a \leq q^{need}$ when $18 \leq s$

$TT = 20 - q^{need}$

Evaluation

- Simulate against SyncAgent, AdaptiveAgent, and BetterAgent
- KanbeAgent outperforms those agents



Thank you for listening