AgentVSC for ANAC SCML 2023 Standard/Collusion Track

Ryoga Miyajma
Tokyo University of Agriculture and Technology, Katsuhide Fujita Lab.

Intoroduction

In the SCML World, it is hard to make a large profits. In the SCML2022 Standard Track, all agents had negative scores. Therefore, it is important to be committed to selling off inventory at a price higher than the costs of buying input products and producing output products.

The Design of AgentVSC

Production Strategy

Produce at the step of arrival of input
→ Easier inventory control

Negotiation Control Strategy

Negotiation Choice

Request negotiations

- Buyer
  - TIME : $\begin{bmatrix} current\_step + 1, \\ \min(current\_step + 3, n\_steps - 1) \end{bmatrix}$
  - QUANTITY : $[1, n\_lines]$
  - UNIT_PRICE : $[0, p_{current\_step}^{max\_for\_buying}]$
- Seller
  - TIME : $[t, t]$
    - t means the first step that $q_t > 0$
    - q_t means the expected unsold quantity
  - QUANTITY : $[q_t/n\_consumers, q_t]$
  - UNIT_PRICE : $[p_{current\_step}^{min\_for\_selling}, 4p_{current\_step}^{min\_for\_selling}]$

Respond the negotiation requests

- TIME conditions
  - max_value>$current\_step$ and min_value<n_steps
- UNIT_PRICE conditions
  - Buyer : min_value≤ $p_{current\_step}^{max\_for\_buying}$
  - Seller : mx_value≥ $p_{current\_step}^{min\_for\_selling}$

Utility Function $U(q, t, p)$

If t or p are very bad, utility value is -1000, otherwise:

- Buyer

$$LinearUtilityFunction(0, -0.25, -1)$$

- Seller

$$LinearUtilityFunction(\frac{current\_step}{n\_steps - 1}, 0, 1)$$

Trading Strategy

Price Control

Determine the unit price at the maximum concession in negotiations

- The highest unit price for buying

$$p_t^{max\_for\_buying} = \begin{cases} cp^{input\_product} & \text{if } t = 0 \\ \max(0.8p_{t-1}^{max\_for\_buying}, cp^{input\_product-1}) & \text{if } I_t > I_{t-1} \\ p_{t-1}^{max\_for\_buying} & \text{if } I_t = I_{t-1} \\ \min(1.1p_{t-1}^{max\_for\_buying}, ap_t^{output\_product} - p^{produce}) & \text{if } I_t < I_{t-1} \end{cases}$$

- The lowest unit price for selling

$$p_t^{min\_for\_selling} = \begin{cases} tp_t^{output\_product} & \text{if } t \leq 0.25T \\ \max(tp_t^{output\_product}, ap_t^{output\_product}) & \text{if } 0.25T < t \leq 0.5T \\ ap_t^{input\_product} + p^{produce} & \text{if } 0.5T < t < T - 1 \\ tp^{output\_product}/2 & \text{if } t = T - 1 \end{cases}$$

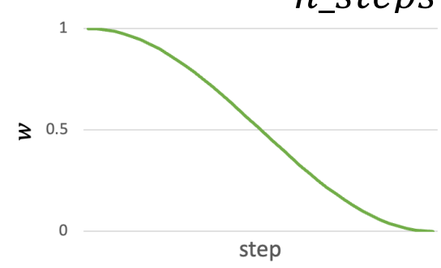
Signing Contracts

Select a combination of signing contracts

- Buyer
  - Sign unless the production limit is exceeded
  - Prioritize contracts with the lower unit price
- Seller
  - For each t, select combinations that
    - all execution dates are step t
    - sum of quantities is the best
  - Under these conditions, select a combination C that maximize $eval(C)$

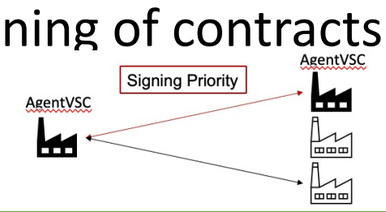
$$eval(C) = \sum_{c \in C} w\frac{p_c}{p_C^{max}} + (1 - w)pr_{partner_c},$$

$$w = 0.5 - 0.5\sin((\frac{current\_steps}{n\_steps - 1} - 0.5)\,\pi)$$

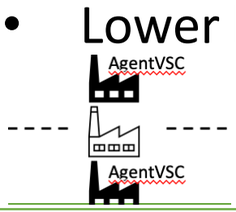


Strategies in Collusion Track

- Prioritize sining of contracts with AgentVSC



- Lower buying prices for factories with high production costs



$$p_0^{max\_for\_buying} = cp^{input\_product} - (p^{produce} - p_l^{min\_produce})$$

- $p_l^{min\_produce}$: The minimum producing cost of AgentVSCs at level l