Shochan

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1 Negotiation Strategy

The Shochan agent I created is basically based on the AdaptiveAgent. The purpose of this SCML2023 is to meet the demand for an agent that satisfies supply and demand. This agent focused primarily on risk management. In this case, we were aware of how to conclude negotiated contracts for various risk patterns, with as little shortage or excess as possible for a given volume of transactions as follows. The basic strategies - Offering Strategy, Acceptance Strategy, and risk management - are described below. The variables needed for explanation are listed below.

$$
\begin{aligned}
p^{max} &: \text{ maximum unit price of the negotiation} \\
p^{min} &: \text{ minimum unit price of the negotiation} \\
p^{accept\_seller} &: \text{ Acceptable price of seller's Acceptance strategy} \\
p^{accept\_buyer} &: \text{ Acceptable price of buyer's Acceptance strategy} \\
p^{offer\_selling} &= \text{Offer price of seller's Offering strategy} \\
p^{offer\_buying} &= \text{Offer price of seller's Offering strategy} \\
my\_needs &: \text{ Needed Negotiation Quantity} \\
tp0 &= tradingpriceofRawMaterials \\
tp1 &= tradingpriceofintermediateproduct \\
tp2 &= tradingpriceoffinishedproduct
\end{aligned}
$$

2 Offering Strategy

For the offer strategy, the offer price at negotiation and the offer quantity are determined. The offer price at the time of negotiation is set as follows, since it is given as two continuous integers in SCML2023. The offer quantity at the time of negotiation is directly related to the content of risk management and will be discussed in that chapter.Shown below are the basic offer prices for sellers and buyers.

$$
p^{offer} = \begin{cases} p^{max} & \text{if } selling \\ p^{min} & \text{if } buying \end{cases}
$$

3 Acceptance Strategy

As for the acceptance strategy, it is basically in line with BetterAgent, the successor to AdaptiveAgent. Acceptance is gradually compromised over time. The upper and lower limits of the compromise price were set using transaction prices. p^{upper_limit} indicates the upper price limit. p^{lower_limit} indicates the lower price limit. The equations are shown below.

$$
p^{accept\_seller} = \begin{cases} p^{upper\_limit} = tp1 \\ p^{lower\_limit} = tp0 \end{cases}
$$

$$
p^{accept\_buyer} = \begin{cases} p^{upper\_limit} = tp2 \\ p^{lower\_limit} = tp1 \end{cases}
$$

For sellers, compromises are made from the upper limit to the lower limit; for buyers, compromises are made from the lower limit to the upper limit.

In addition, because of the shortage penalty and the excess penalty, it is necessary to sell and buy as much as possible in equal numbers, but basically the shortage penalty is larger, especially in the case of buyers compared to sellers. Therefore, the receiving strategy was determined by comparing the disadvantage caused by the deficiency penalty and the disadvantage caused by the excess penalty.

4 Risk management:

We will describe the measures we have taken in response to the following three cases of adverse negotiation patterns that often occur.

The first is that multiple offers are decided from submitting offers to multiple agents at the same time, which is more than necessary. The first problem was addressed by making a diversified offer. By spreading out the offers, even if multiple offers were to be accepted Contracts can be signed with little risk. When the contract is made in small quantities, the contract can be made in subsequent steps, but When the contract is made in quantities such as double the amount of the transaction given at the beginning, the penalty will be large.

The second is when the offeror overlooks a deal that could be obtained by compromising a little when making the offer. For the second problem, since there are only two prices that can be proposed this time, it is likely that a large or small price will be the decisive choice. However, by proposing the opposite price only a few times, we created a chance to conclude a contract due to the coincidence of interests.

We also believe that it is effective to propose one less number in the hope that the other party will propose a different amount since there is little hope of successively proposing the same number.

The proposed strategy resulting from the measures is shown in equation and figure.The figure shown as an example shows an agent's negotiation, with Shochan's offering quantity and offering prices shown as light blue lines. From this Figure 1, it can be seen that the agent initially proposes 10, 9 and the required amount, and then alternates between the required number of proposals and half of the required number of proposals. Also, Figure 2 shows that the sixth step is a proposal in which the price is reduced by one, and that the negotiation is concluded with only one price concession. Although there are only two types of prices, we believe that making a concession of even one price is very effective.

$$q^{offer} = \begin{cases} my\_needs & \text{if } n = 1, \\ max(my\_needs - 1, 0) & \text{elseif n} = 2 \\ \dfrac{my\_needs + 1}{2} & \text{elseif n}\%2 = 1 \\ my\_needs & \text{otherwise} \end{cases}$$

$$p^{offer\_seller} = \begin{cases} pmin & \text{if } n = 6 \\ pmax & \text{otherwise} \end{cases}$$

$$p^{offer\_buyer} = \begin{cases} pmax & \text{if } n = 6 \\ pmin & \text{otherwise} \end{cases}$$

5 Evaluation

Table 1: The test results of Gentle

Agent	score	min	Q1	median	Q3	max
Shochan	1.246431	1.18363	1.21045	1.240185	1.2899125	1.31136
AdaptiveAgent	1.201007	1.14935	1.1578	1.19602	1.2354925	1.28315
LearningAgent	1.177515	1.06543	1.13654	1.16426	1.24264	1.28166
BetterAgent	1.1644819	0.972089	1.12404	1.17385	1.2146025	1.27132

Shochan was tested in simulations against the tutorial agents, AdaptiveAgent and LearningAgent and BetterAgent. The simulations were run for 30 days in each of the 12 worlds. The results were run 10 times and the mean, minimum, Q1, Q2, Q3, and maximum values are shown in Table 1. The results show that, on average, Shochan produced a large difference from the other agents. It also shows that Shochan is superior and more stable than the other agents in all the indices.

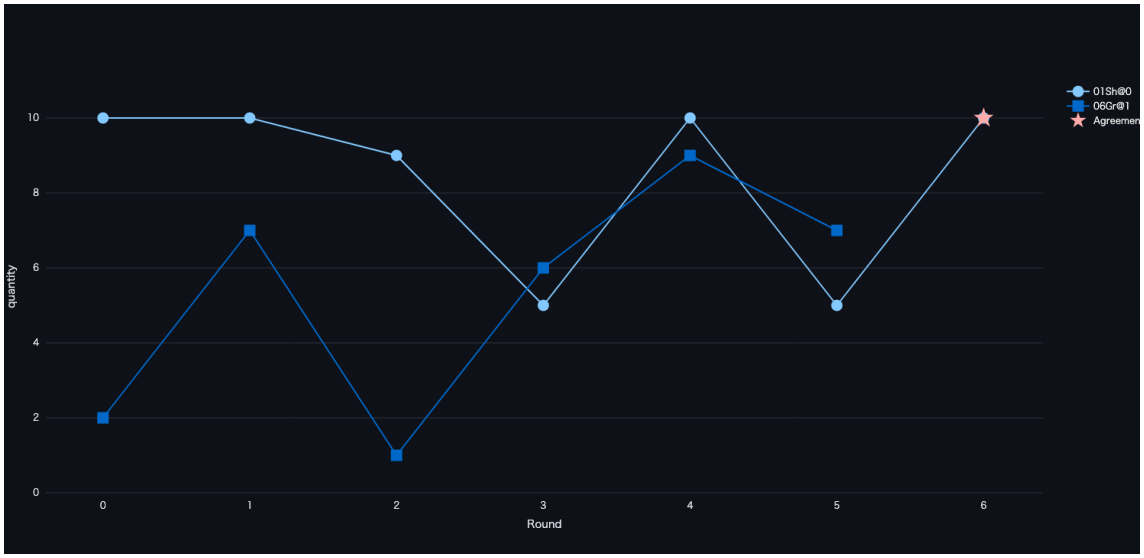

Figure 1: offer_quantity

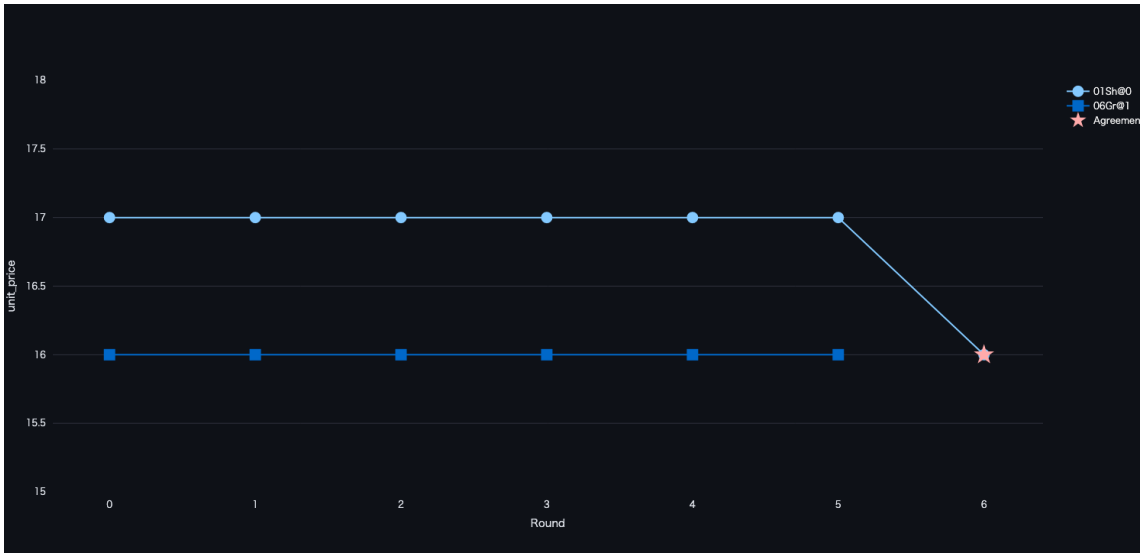

Figure 2: offer_price