Chapter 12
AgentMR: Concession Strategy Based on Heuristic for Automated Negotiating Agents

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Abstract The Automated Negotiation Agents Competition (ANAC2012) was organized. Automated agents can alleviate some of the effort required of people during negotiations and also assist people who are less qualified in the negotiation process. Thus, success in developing an automated agent with negotiation capabilities has great advantages and implication. In this paper, we present the strategy of the agent (Agent MR) based on the heuristic. We show the method of searching for the bid effectively and also discuss how to control concession.

Keywords Automated negotiation competition • Multi-agent system • Multi-issue negotiation

12.1 Introduction

The third international (ANAC2012) was held [1]. At ANAC, researchers proposed agents that had various strategies (e.g. [2]). It is likely that the strategies of an agent can be applied to real-life negotiation problems.

We developed a negotiation agent for ANAC2012 that can negotiate on various negotiation problems [3]. In this paper, we present a method to search efficiently on the various domains, and we discuss how to of the opponent in order to grasp the characteristics of the opponent.

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12.2 An Implementation of Negotiating Agents Based on Heuristic Strategy

12.2.1 Method of Searching for Bid

In the setting of the competition, a multitude of domains has many *issues*. The number of bids is proportional to the number of issues and each issue's elements. In particular, if the domain has many bids, a simple method like a full search has difficulty in searching for a bid that has high utility. Therefore, it is necessary to consider a method for searching efficiently on the domain.

We search for the bid based on the that one's own bid has similar utilities. When a certain bid changes one point at issue, we speculate that it has similar high utility. Table 12.1 gives an example of a method of searching for the bid. In Table 12.1, we can search for the bid that has high utility when we change the element of issue at *shirts*.

The method of based on a heuristic is effective in with many points at issue. This leads to early agreement since the search was completed at an early stage. Moreover, we search its own search space, as well as the opponent's space. In the setting of competition, it is important that we examine the strategy that can search immediately and effectively since one negotiation has a time limit. Figure 12.1 is a graphical representation of the average of utilities and the number of bids in one's own best bid in the ANAC2012 final rounds (exclude *Energy* domain).

Simulation results show that the proposed strategy can search for a bid with high utility. On the other hand, average of utilities is low in some domains that have few issues.

12.2.2 Evaluating Characteristics of Opponent

Since an agent's own is not mutually taught to the other agent, information that can be used for strategy construction is scarce. Therefore, a compromising strategy needs to be studied based on information such as the details of the domain and the characteristics of the opponent.

The main idea of strategy is to compute concessions of the opponent in order to grasp the characteristics of the opponent. Concretely, a concession of the opponent is calculated as follows. Let $\mathcal{D}$ be our set of domains. Agent A negotiates with B on

Table 12.1 Method of searching for bid

Shirts	Pants	Shoes	Accessories	Utility
Blouse	Leather pants	Sneakers	Sunglasses	1.00
Sweaters	Leather pants	Sneakers	Sunglasses	0.94

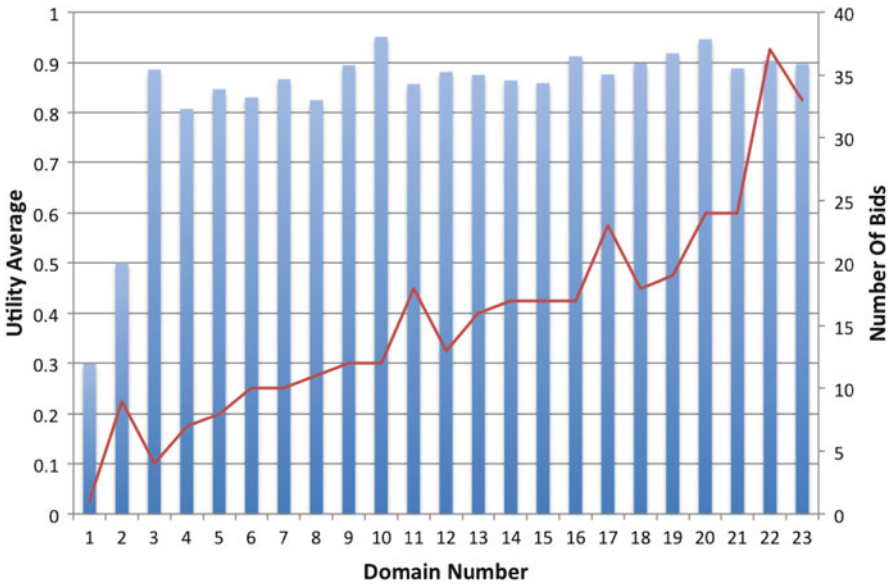

Fig. 12.1 Result of searching for bids in ANAC2012 final rounds

domain $D \in \mathcal{D}$, if they reach the certain bid ω, in which a concession degree of B on utility space of A is defined as expression (12.1).

$$\lambda = \frac{U(\omega) - U(\omega_{rivalFirst})}{1 - U(\omega_{rivalFirst})} \tag{12.1}$$

$U(\omega)$ is the utility of the bid ω on an agent's own utility space. $U(\omega_{rivalFirst})$ means the first bid of the opponent on its own utility space.

The λ shows the feature of opponent behavior. In addition to this barometer, we define an agent's own lower limit of the concession degree U_{myMin} on its utility space as follows:

$$U_{myMin} = U(\omega_{rivalFirst}) + (1 - U(\omega_{rivalFirst})) \cdot \epsilon \tag{12.2}$$

ϵ is the coefficient for adjustment of concession, and is defined based on the concession degree λ. By using the lower limit U_{myMin}, the agent works at compromising to the estimated optimal agreement point.

12.2.3 Control of Concession

We concede slowly using the *sigmoid*-based function. Concretely, our behavior is decided based on the following expression (12.3).

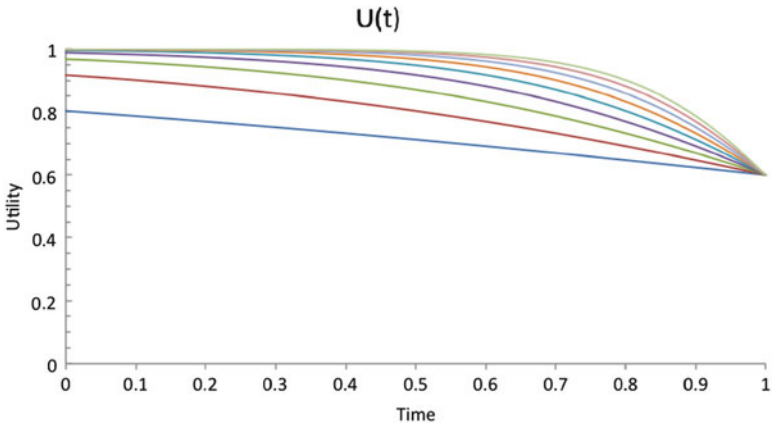

Fig. 12.2 $U(t)$ when α is changed from 1 to 9

$$U(t) = 1 - \frac{1}{1 + e^{-\alpha(t-\beta)}} \tag{12.3}$$

$U(t)$ is calculated by the when the timeline is t. α is called *gain* at this function, and we use it for adjustment of the speed of concession. β is used for adjustment of the concession degree at t. β is defined so that U_{myMin} equals $U(t)$ at the deadline ($t = 1$).

$$U(1) = U_{myMin} \tag{12.4}$$

Therefore, β is defined as follows:

$$\beta = 1 + \frac{1}{\alpha} log \left(\frac{U_{myMin}}{1 - U_{myMin}} \right) \tag{12.5}$$

Figure 12.2 is an example of $U(t)$ when α is changed from 1 to 9. The horizontal axis shows the passage of time of the negotiation. The vertical axis indicates the effect value that the agent obtains. The curve $U(t)$ approaches U_{myMin} with time passage.

12.3 Conclusion

In this paper, we argued a basic strategy for Agent MR. We presented details of the strategy, which is a method of searching for a bid. This strategy based on the heuristic can search for the bid with high utility at an early stage. Moreover, we explain how to concede in order to follow the opponent's behavior. It is possible to adequately estimate the opponent's concession degree control.

References

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